The Foundry

for January

Yours Received And in Reply

YOU ask should you fire a molder that makes over 10 per cent scrap loss? Should you, late molder, foreman, salesman or office boy grown up to be head of a business continue to be a scrap maker? Is that molder's 10 per cent worse than the 10 per cent you lost of your firms money last year?

Look at your plant and your competitors'. Many dingy, dark and dirty, a disgrace to American industry should have been written off the books years ago. Only a few out of thousands of foundries are modern, light, clean, orderly and fit for human beings. Little wonder that other trades appeal to boys.

Some have installed some new equipment, but most still are making the old stuff work.

THE FOUNDRY has rapped your customers for lack of decency and fairness in buying. Now we say to you, Mr. Foundryman, your plant is worn out. Your equipment, decrepit or obsolete, is junk. Your methods and thinking are as bad as your plant.

Business rebuilds as it comes out of the depression. Foundries must rebuild. You must equip, modernize and give your men tools and equipment comparable with other industries.

No other manufacturer permits his customer to impose bad tools. Forging makers get proper dies. Foundries must have good patterns, designed and made right. Demand them.

You must *sell* your castings at a profit. When we say *sell* we mean sell. And when we say *profit* we mean profit.

With tonnage increasing, get more per ton. If you say you can't, quit. If you don't charge more, don't talk about cut-throat competitors and dirty buyers. Get enough out of every sale to help pay for modernizing. Begin at once. Have self respect to earn enough to let your men live and work like human beings.

You ask about a molder's 10 per cent scrap loss! Look in your mirror. Look at your plant. Look at your profit and loss statement. Are *you* a worse scrap maker?

Learning Thrives

EIGHT chapters of the American Foundrymen's association approach mid-season of a busy year. Numerous local foundry groups gather for periodic meetings. District conferences in Birmingham and Lansing, Mich., are immediately ahead. The fortieth annual convention with its foundry and inter-allied exhibition is in the offing. Technical knowledge is tremendously stimulated in the foundry industry. Four lean years have passed. With learning to the front, 1936 is the first fat year.

What's a Good Foreman Worth

TWENTY-FIVE years ago, foremen ran foundries. They planned jobs, hired and fired, inspected finished product, bought supplies and even sold castings. Those men became managers and owners. The War brought changes. Larger plants were built.

Work was centralized. Specialization changed the type of foundry foremen, particularly in big foundries.

Now production departments plan jobs. Personnel directors hire and fire. Inspectors pass or reject work. Purchasing agents buy materials. The foreman assigns work and keeps an increasing number of records. Only in small foundries and some departments of heavy work shops does foremanship attract men with the all round qualities of twenty-five years ago.

Industry has lost through this change. Skill and knowledge gained only through experience is becoming rare. But the greatest loss is in industrial relations. The old time foremen brought workmen and owners closer. They promoted harmony. A good foreman is worth more than titled, but inactive, executives.

Editor

MALLEABLE FOUNDRY DUPLEXES

Fig. 1 (Above)—Rear view of cupola with air furnace in background and coal pulverizer unit at the left. The cupola slag hole is at one side instead of at the back opposite the spout. Fig. 2 (Below)—The ladle shank extends only on one side

GRATIFYING reduction in production cost in the malleable iron foundry of the Eberhard Mfg. Co., Cleveland, is claimed as the result of installing new melting equipment and of adopting a changed program of distributing and pouring the iron and shaking out the castings. The general program has had rather wide acceptance for many years in various branches of the gray iron and steel foundry industry, but for various reasons has not been introduced to any marked extent in the malleable iron foundries. Tradition and custom, to a certain extent are responsible for the practice of molders working on light work to pour their own iron and shake out their castings. This is particularly true where the metal is melted in an air furnace, brought to the desired analysis and then has to be distributed in the shortest possible time in hand ladles.

For many years this practice was followed in the foundry of the Eberhard Mfg. Co. where the metal was melted in five air furnaces located at various points to reduce the distance the metal had to be carried from any individual furnace. This meant the maintenance of a crew on each furnace and the trucking of fuel and iron to the various units. The foundry is laid out in the form of a large *T*, with the head of the *T* approximately 600 feet in length and the stem about 400 feet. Molding machines occupy space close to the walls and the floors extend from the wall to a central gangway in each of the two main bays.

Under a new arrangement inaugurated a year ago all the metal is distributed from a single melting unit located close to the junction of the two members of the *T*, or approxi-

WITH CUPOLA AND AIR FURNACE

Fig. 3 (Above)—Side view of duplexing unit with air furnace at left, cupola at right and spout connecting the two at the back. Fig. 4 (Below)—Slag is removed from the bath by a water cooled skimmer riding on a roller

mately in the center of the foundry. In one bay extending east and west from the furnace the metal for the most distant floors has to be carried about 300 feet. In the other bay extending north and south the floors at the extreme end are about 400 feet from the furnace. However, the molten metal is carried in 500-pound bull ladles suspended from a monorail and the loss in temperature is negligible. At the ends of the floors the metal is transferred to hand ladles and distributed to the molds by expert pourers. The molders continue at their legitimate work of making molds throughout their entire working period each day. A marked differential between the rates of compensation for molders and pourers, plus the increased daily production on each floor, are among the advantages claimed for this method. A labor gang also shakes out the molds and removes the castings, after which the sand is cut over by three machines made by the American Foundry Equipment Co., Mishawaka, Ind.

The central feature of the new system, the feature upon which most of the other practice is predicated, is the melting unit installed by the Whiting Corp., Harvey, Ill. Briefly, this is a duplexing unit in which the metal is melted in a cupola and treated further in an air or reverbatory type furnace fired with powdered coal through two burners at one end. Composition and physical properties of iron made by the duplexing process meet all standard requirements. Compactness of the unit is shown in Figs. 1 and 3. In Fig. 1 the cupola appears at the right, the coal pulverizer at the left, while the reverberatory furnace is shown in the center background. In Fig. 3 the back of the air

furnace appears at the left, the cupola a little to the right in the center background, while the long spout connecting the two furnaces and pitched at an appreciable angle appears in the center background. The front, or tapping side of the air furnace is shown in Fig. 5 with the powdered coal connection at the right and part of the cupola shell showing in the center background.

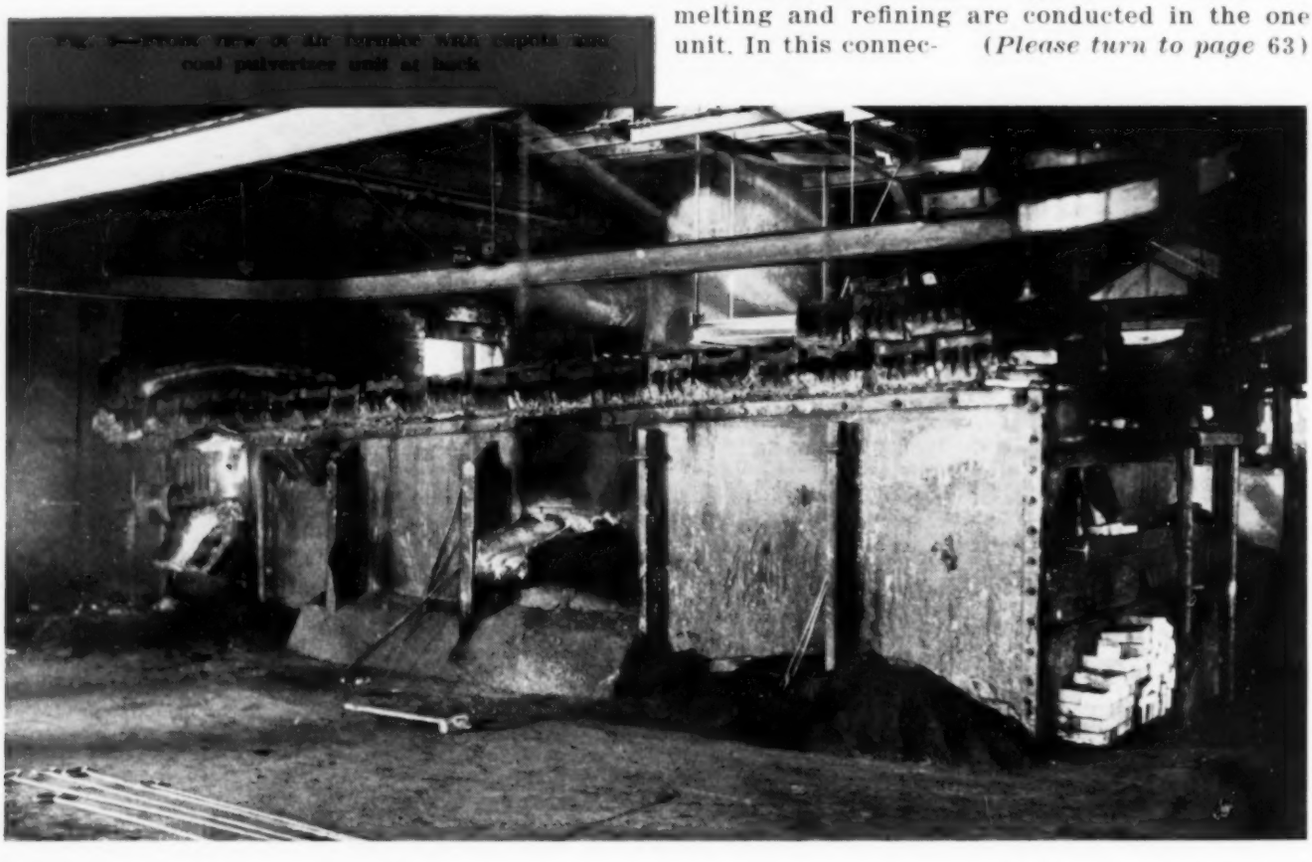
Lined to 48 inches the cupola has a melting capacity of 12-13 tons per hour and is designed with windbox and pendant tuyeres for continuous operation. The 2000-pound charges made up of 55 per cent hard iron return scrap, gates and sprues, 10 per cent malleable pig iron, 15 per cent steel scrap, and 20 per cent malleable scrap are divided by coke splits of 235 pounds in the early part of the heat and 225 pounds later with 75 pounds limestone per charge used as flux. Blast from a positive pressure blower is supplied at 4500 cubic feet per minute, but may be increased or decreased by a governor on the blower and by a gate in the main blast pipe to meet fluctuating conditions.

This cupola is rather unique in that the charging door is several feet higher than usual and that the cupola is not surrounded by a charging floor. The high door enables the furnace to hold 8 or 9 charges. No charging floor is needed because the cupola is charged mechanically. Outside the building in the immediate vicinity of the cupola, steel drop bottom buckets shown in Fig. 6, are loaded on a depressed scale from stock piled in the neighborhood. Indicator beams on the scale are set for the required weight of the component parts of the charge and the attendants load the required amount of each until the beam rises. Thus each bucket holds the correct amount of all ingredients for the charge. A 3-ton electric hoist mounted on a runway lifts the bucket, travels forward, lowers the bucket into the cupola and trips the bottom to deposit the charge in the cupola. On the return journey the empty bucket is deposited on the scale, the hoist is attached to a loaded bucket and the operation is repeated as often as necessary.

The Iron Stream Runs Continuously

Operating at approximately 60 per cent of capacity, the daily heat is 60 tons. The blower on the cupola is started at 9:00 a. m. and about 15 minutes later the tap hole is opened to allow the accumulated iron to flow through a long spout into an opening in the side wall of the air furnace. Thereafter the tap hole remains open for the duration of the heat. By 11 a. m., the air furnace contains approximately 16 tons of molten iron which has been manipulated to the desired analysis and is ready for distribution. The carbon has been reduced from 3.20 to 2.70 per cent, while silicon shows 0.85 per cent, manganese 0.40 per cent, sulphur 0.14 per cent, phosphorus 0.13 per cent.

Since the slag flows continuously from the cupola, the amount to be removed from the bath in the air furnace is considerably less than in ordinary air furnace operation where the melting and refining are conducted in the one unit. In this connec- (*Please turn to page* 63)



Technical Program Carries Innovations

TECHNICAL sessions scheduled for the coming Detroit convention and exhibition of the American Foundrymen's association, will be held only in the mornings and evenings. This innovation has been adopted by the program committee to permit all convention visitors the maximum of time for examining the extensive exhibits of foundry equipment and supplies and visitation of the many interesting foundries located in and around the center of automobile production.

Monday, May 4, the first day of the convention and exhibition, will be devoted to the opening of the foundry and allied industries exposition, committee meetings, and registration. The technical meetings will begin on Tuesday morning, May 5, and will continue through Friday evening, May 8. The malleable cast iron division program committee has planned two sessions, one to be devoted to malleable foundry sand problems and the second to general phases of the production and metallurgy of malleable castings. The malleable program committee is headed by A. M. Fulton, Northern Malleable Iron Co., St. Paul, Minn. and includes the following: Phil C. DeBruyne, Moline Malleable Iron Co., St. Charles, Ill.; E. A. Gullberg, foundry supervisor, Deere & Co., Moline, Ill.; and Leo J. Kelley, Fort Pitt Malleable Iron Co., Pittsburgh.

The steel division program committee has arranged two sessions, one being a symposium on the cleaning of steel castings. Steel division program committee has the following members: John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; George Batty, consultant on steel castings, Drexel Hill, Pa.; H. D. Phillips, Dodge Steel Co., Philadelphia; and Jerome Strauss, Vanadium Corp. of America, Bridgeville, Pa.

The program committee of the cast iron division has tentatively scheduled a review of the report on alloy cast iron. This program should provide discussions of exceptional value to the industry. The report has been in preparation for more than a year, and is being developed by 43 experts in the metallurgy and production of alloy cast iron, under the chairmanship of H. Bornstein, Deere & Co., Moline, Ill. The report will consist of sections on alloy elements, metallurgical theory, properties of alloy iron, white and chilled alloy cast iron, specific applications, foundry practice, and heat treatment.

Other papers on gray iron tentatively scheduled for the convention cover such subjects as "Copper and Copper Manganese in Cast Iron"; "Measuring Polish on Cast Iron"; "Determining the Height of Molten Metal in the Cupola"; "Control of Silicon and Manganese in the Cupola"; and "Heat Treated Cast Iron". The committee in charge of the cast iron program consists of J. S. Vanick, International Nickel Co., New York, chairman; H. C. Griggs, Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.; H. H. Judson, Goulds Pumps Inc., Seneca Falls, N. Y. and John Lowe, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.

Nonferrous division will present the first of a series of papers on details of foundry practice for the production of castings and outstanding types of alloys. Papers on silicon bronze, manganese bronze and aluminum bronze practice are being prepared for presentation at the Detroit meeting. The committee on recommended practices expects to present a report on several alloys, prepared in similar form as that which was presented at Toronto in 1935 on aluminum alloys and which attracted considerable favorable comment and discussion.

A number of technical sessions will be of general interest to all groups of foundrymen, including meetings on (*Please turn to page* 70)

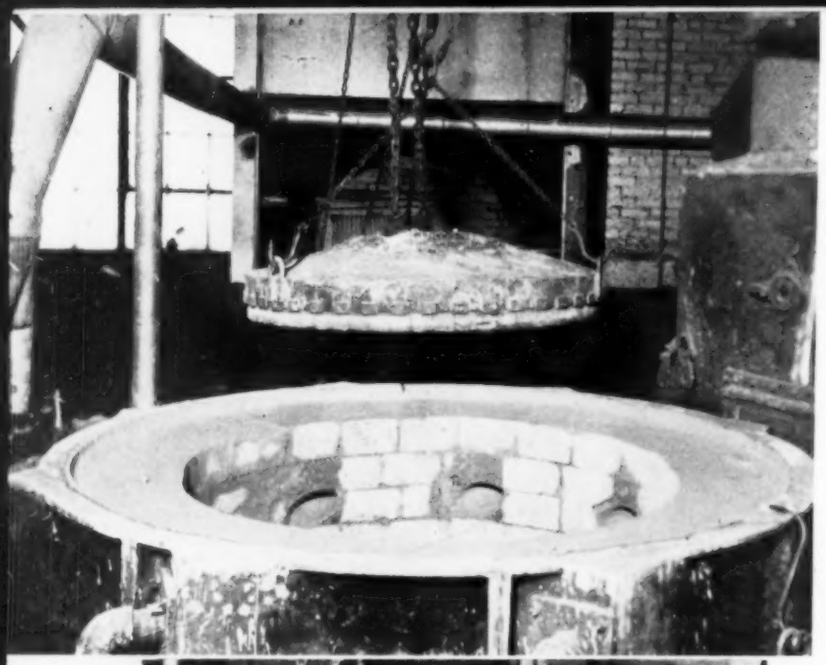


Fig. 1—Burner ports enter downward and at a tangent Fig. 2—The furnace is at one side and in front of the cupola

Superheats and Refines Gray Cast Iron

By EDWIN BREMER

NEW developments and innovations in industry often result from side excursions undertaken during or resulting from an original investigation, rather than from the investigation itself. While many examples might be cited to substantiate that statement, this discussion will be confined to one relating to a new auxiliary melting unit, an adjunct to that well-known and useful foundry device, the cupola. The new unit is gas-fired, of simple construction, easy to operate and has been in practical operation for an extended period for the production of high-quality gray and alloy cast irons. This development was not due primarily to an investigation of the melting with the idea of producing a unit that would possess advantageous features, but from an investigation to improve gray iron by careful desulphurization to obtain the lowest possible sulphur content.

The round-about way in which the development took place is interesting. In 1929, Edward Miller, who for a great many years had produced glass house machinery used widely throughout the world, decided to establish his own foundry for the production of glass molds. Shortly thereafter, a new plant was constructed and placed in operation as the Miller Foundry Co., Columbus, O. His son, F. E. Miller, at that time just graduated from college, became interested in the work being done in the foundry, and decided to learn more about it. Consequently, he entered the foundry as a laborer, aiding in charging the cupola and performing the other work incidental to the production of castings. Later he worked in the cleaning room and then became a molder's helper. When he had acquired a good working knowledge of molding, he went into the coreroom, and following that was placed in charge of the cupola. As a result of his practical experience, he gained a good insight into the various problems relating to the production of iron molds used in making a variety of glass products.

The next natural step in his training was to make contacts with users of products of that foundry. In that way he obtained first-hand knowledge of conditions under which the molds were used, and how the molds stood up under service. While he found that the molds made by his firm gave excellent service, he came to the conclusion that it might be worth while to study the various phases of glass mold production to see whether some notable improvement might be made especially in serviceability.

Glass molds must be dense in structure, resistant to comparatively high temperature and growth occasioned by repeated heating and cooling, and fine grained. In considering those properties the thought occurred that desulphurization might result in a favorable improvement of those properties. Consequently, to test his theory, he had installed at the cupola, a forehearth so that the sodium carbonate used in desuphurizing could be employed effectively and efficiently.

With the idea of carrying the experimental work further, it was decided to superheat the iron in some way to see what benefit would be obtained. Since the forehearth already was available at the cupola, the most logical step was to insert burners in it rather than to try and build another unit. However, the idea was not a success. While the iron was superheated to some extent at the beginning of the operation, the superheating effect decreased as the height of metal increased in the forehearth, even though there was no cessation of the heat applied by the burners. On first consideration it was rather difficult to understand why the metal temperature should not increase, since external heat was added continuously. After some study and numerous experiments on the problem, it was found that the difficulty was in the depth of the bath.

Consequently, a new furnace was built in which the bath was not so deep. Three gas burners, spaced equidistantly, were used. That furnace was 36-inches in diameter, about 4-inches deep from the bottom of the burner opening, and held approximately 1000 pounds of molten metal. The furnace gave encouraging results and eventually led to the development of a practical working unit which possessed numerous features for controlling the metal superheated in it. Constant experiment with the furnace led to a specific arrangement of the burners, and later to the construction of a larger furnace with four times the capacity of the original unit.

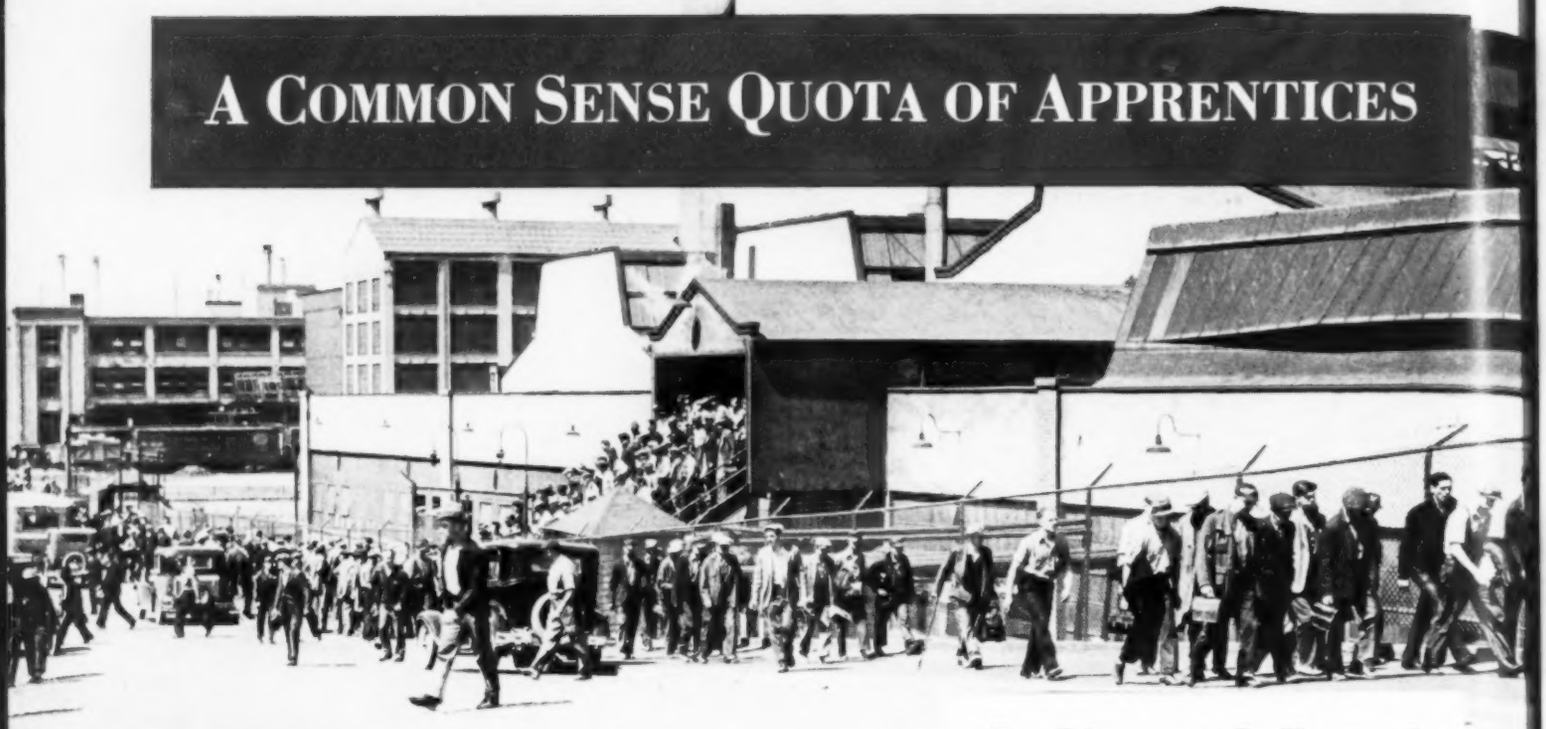
Fig. 4—A representative group of castings made from iron refined in the new furnace. Note the high polish which can be obtained on the surface

This furnace, shown in Figs. 1 and 2, is erected on a brick base so that the tap hole is 36-inches above the floor. The furnace proper is built within a sectional cast iron shell 60 inches in diameter. The furnace bottom is composed of two layers of regular firebrick laid flat so that the bottom is about 4 inches thick. The side wall of the furnace is made up of regular 9-inch cupola blocks so that the interior diameter is 42 inches. Seven burners spaced equidistantly around the furnace, supply the heat. Their location is such that they enter at a tangent of about 30 degrees to the circumference, and also are directed at an angle of approximately 45 degrees downward. Openings of the burners inside the furnace are about 7½ inches above the bottom of the furnace.

That arrangement of the burners resulted from considerable experimental work, and it was found that such positioning resulted in a circular motion of the molten bath, which apparently (*Please turn to page* 67)

Fig. 3—The firm specializes in glass-house molds, and this shows a floor of molds just before pouring

A Common Sense Quota of Apprentices



By Clement J. Freund

You cannot graduate more apprentices than you and your competitors can employ

TALK to the average foundryman about limiting apprentices and he goes to the ceiling, as we say. It is a part of his code of ethics or behavior even though he trains no apprentices and doesn't intend to. Just the same, you can train too many apprentices. If your hopeful young apprentices meet older boys who completed your molder apprenticeship and have not worked a day since, either in your shop or elsewhere, your fine apprenticeship program will go to pieces.

And it will go to pieces if you cannot win and hold the confidence of the boys' parents. Your son's course in engineering or medicine is a very important business to you. It is the preparation for his whole career. Your apprentice training program is just as important to the parents of your apprentices and for the same reason. To the parents apprenticeship means admission to a select craft in which their sons shall be reasonably secure, all their lives, from the many hardships and privations which they themselves suffered.

You cannot graduate more apprentices than you and your competitors can employ under normal conditions. That is, you can't do it very long. Some limit has to be set whether you like the word or not; no absurd, arbitrary limit, but a limit based on facts and common sense.

"Well, then, just how many boys should I train?" Another question is the answer to yours. "Just how many skilled men do you lose?" You should graduate every year as many apprentices as the number of molders, coremakers and other skilled men who leave you each year.

If your plant is not very large you can go over your employment records yourself and in a few minutes check off the names of really skilled men who have left you in recent years. It might be well to include in your count one year in the early Twenties, one year late in the Twenties, and a recent year. That gives a good spread and the average of the three should be a good figure to work with. Of course you must leave out those men who were laid off for lack of work.

If your plant is large you may have to distribute lists of former employes to your superintendents and department heads and tell them to designate those who were skilled men. In that case the superintendents and department heads must know beforehand just what you mean by a skilled man.

Let us say that you lose an average of eight good molders in a year. Then you must graduate eight apprentices every year.

And that means that you need to hire at least eight apprentices per year.

But eight per year will not do. You will find as you go along that a few always drop out because they lose interest, lack strength or health, or for other reasons. Out of ten boys, an av-

erage of two may leave in the first year and one thereafter, so that only 70 per cent of your starters actually finish. Accordingly, you need to hire ten sevenths, or 1.43 times eight every year.

Of course, you can't hire a fraction of a boy but let the decimal stand for the time being.

The longer your experience with apprentices, the fewer of them will leave you. Apprentice turnover can be kept at the incredibly low figure of less than 2 per cent per year. It has been done.

Another item enters into the calculation. Not all apprentices who graduate may choose to remain in your shop. Some of them, for example, may wish to round out their experience by working in different types of plants. If two out of ten graduates can be expected to leave, they introduce a new factor of ten eighths, or 1.25, and to keep eight apprentice graduates per year you will need to hire 1.25 times 11.43 every year.

And that amounts to 14.28.

You can safely disregard this factor if yours is one of a group of foundries in a community and there is a fairly even exchange of apprentice graduates between them.

Again, you may be planning new departments which will increase your requirement for skilled molders. Or you may have it in mind to mechanize one or the other department and reduce the requirement. If you have made a careful analysis which discloses that new machinery which you contemplate will cut down your total requirement for good molders by 12 per cent, then you need put on every year only 88 per cent of 14.28.

And the number of boys to be hired drops to 12.56.

But don't make the familiar mistake of assuming that molding machines eliminate the need for skill. If you have the machines you can get along with less skilled men, it is true, but those few must be better trained than ever because they will have charge of the machines and supervision demands much more skill than mere production.

So far we have been talking only about replacing the molders you lose. But that may not be your whole problem. You may be shorthanded to begin with. Perhaps you could use ten more molders than you have, even if an apprentice graduate could take the place of every one who leaves. You will need extra apprentices to make up this deficiency. How many will depend upon the number of years in which you desire to make up the shortage. Let us assume that you wish to make up the shortage of ten molders in the first 2 years of your apprenticeship program, or five each year. You already know that you need to hire 14.28 apprentices every year to graduate eight of them 4 years later. If 14.28 will produce eight, then by simple proportion, 8.92 boys hired per year will graduate five. And if 8.92 are added to 12.56,

The annual quota to be hired becomes 21.48.

When you have made up the shortage, you can reduce the quota to 12.56. And you obviously will hire either 21 or 22; probably 22 is the more conservative number.

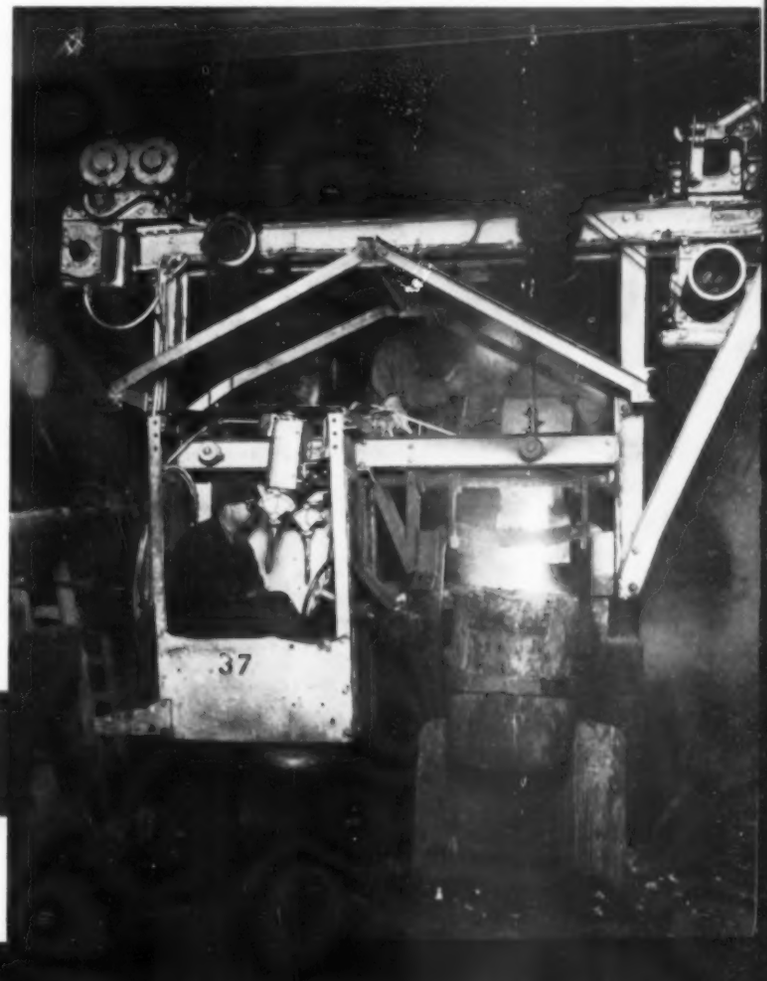
If you are keen about scientific management and think you should have this in terms of a formula, here it is:

$8 \times 1.43 \times 1.25 \times 0.88 + 8.92 = 21.50$ or 22, the number of apprentices to be hired per year. In this formula,

- 8 = skilled molders lost per year,
- 1.43 = correction factor for loss of apprentices before graduation,
- 1.25 = correction factor for loss of apprentices upon graduation,
- 0.88 = correction factor for mechanization of departments, and
- 8.92 = additional apprentices to make up existing shortage of molders. This item disappears when the shortage is made up.

But you may tell me "I'm not interested in the number of boys to be hired every year; I want to know the number of apprentices I should maintain in (*Please turn to page* 75)

Illustrations Courtesy General Motors Corp.



You may have it in mind to mechanize one or the other departments

STEEL CASTINGS IN MOLDS

This is the second of Four Articles

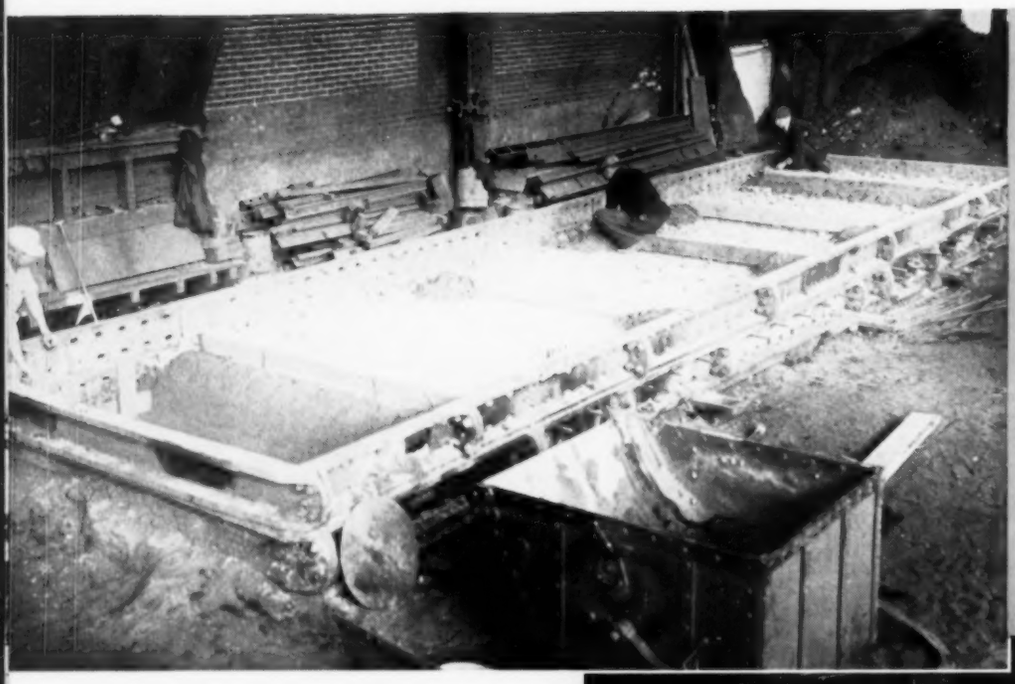


Fig. 1—Parallel straightedges are set up in the drag to form the bed

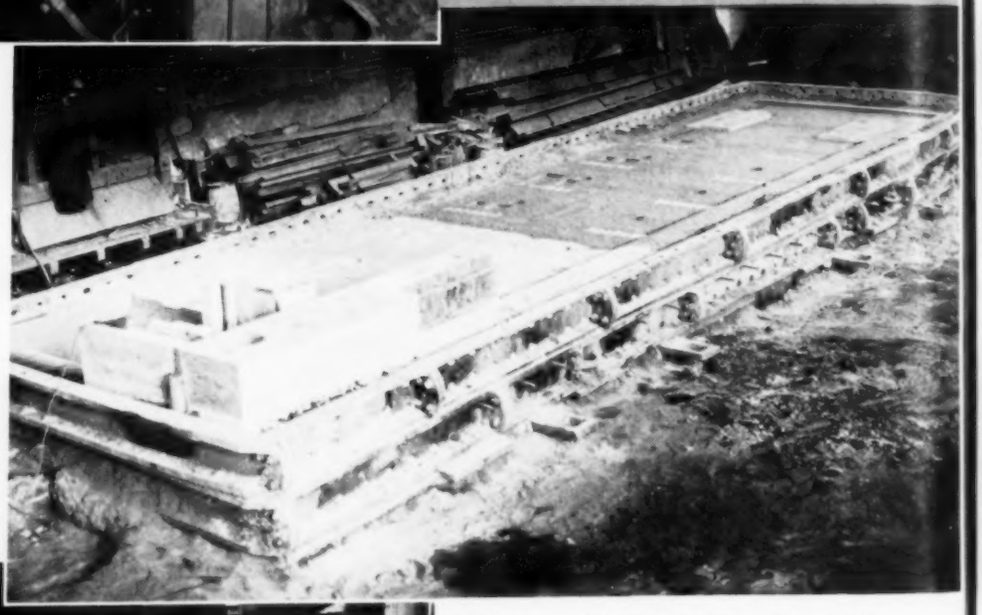


Fig. 2—(Above)—Mold with first cores at one end. Fig. 3 (Left)—Mold as it appeared with nearly all cores in place

AMONG the claims advanced for the cement bonded sand molding process now practiced at the plant of the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., is that the castings —less natural shrinkage— conform accurately to the size and shape of the pattern. This irrespective of whether the mold is made up of two simple parts or assembled from a considerable number of individual parts. This is due to the fact that each block of cement bonded sand retains the exact impression of the pattern or corebox and does not sag or become distorted in any manner. With certain exceptions to be noted later where the sand is swept to form a foundation, or rammed directly against a pattern in a flask or pit, the blocks of sand to form a mold are made in the usual type corebox, turned out on planed plates and allowed

ARE PRODUCED BONDED WITH CEMENT

By PAT DWYER

Fig. 4—Sink heads are carried the desired distance above the casting in cement bonded sand blocks

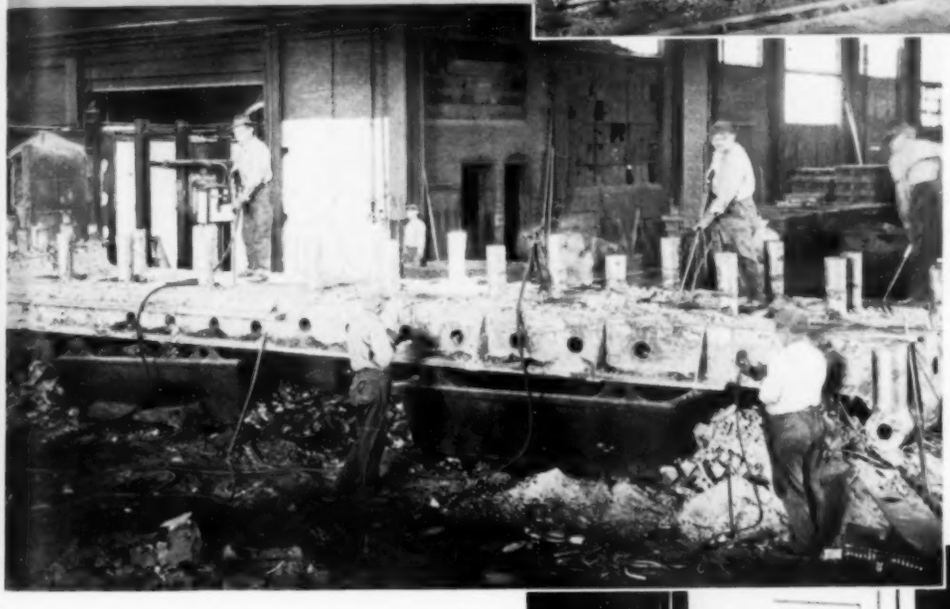
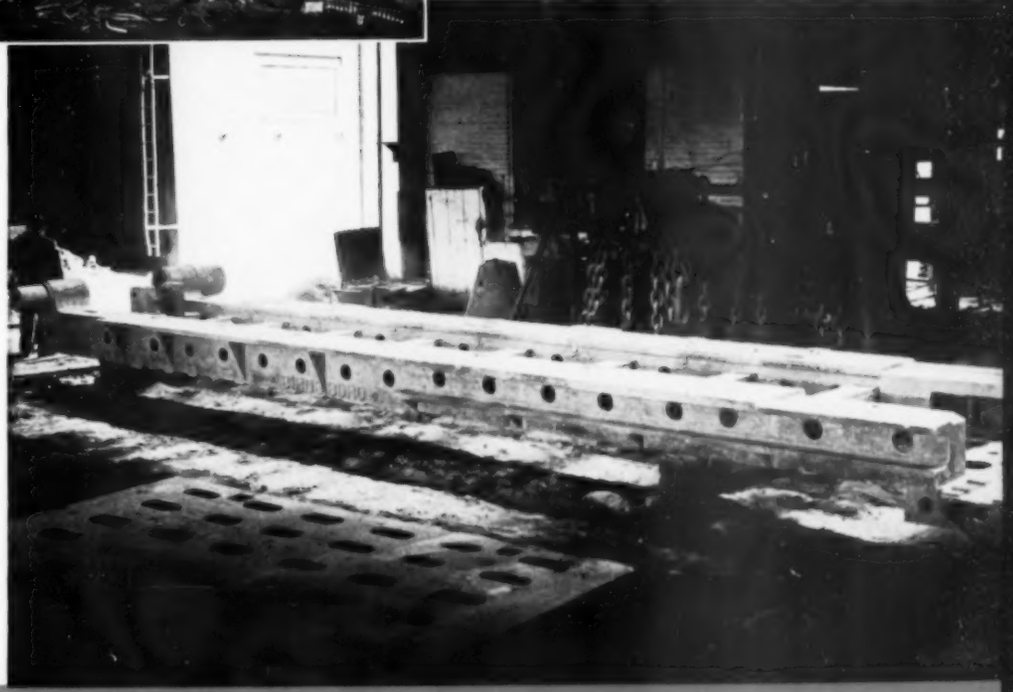


Fig. 5 (Above)—The mold material readily is knocked away from the casting. Fig. 6 (Right)—The cleaned casting straight and true to shape and dimensions

in green sand, but it is a feature of considerable interest in foundries where all or nearly all the molds are dried. Construction, maintenance and operation of the ovens constitute an appreciable item of expense. In addition the ovens usually occupy valuable floor space which at times might be devoted to more profitable use.

Before the present method to remain undisturbed until they have air dried and hardened. This stage occupies a minimum of 24 hours, depending on the mass to be dried. The dried blocks then are assembled and fit into place accurately like so many blocks of cut stone. A typical large casting molded in this manner is shown in Fig. 6.

Another feature of interest in connection with the new method is that no ovens are required to dry the molds. This feature of course has not direct appeal to foundrymen operating entirely



was adopted at Birdsboro, practically all the molds made in the main foundry were dried in large oil fired ovens located in the enter of the foundry between the two main bays each 700 feet in length. Molds were made in one bay, loaded on cars and pulled by cable into the ovens. After they were dried they were pulled out through the opposite ends of the ovens, unloaded and set up on the pouring floor in the second bay. This practice represented ordinary routine, but as with regular routine in any steel foundry producing a wide range of miscellaneous castings, the routine had to be varied occasionally. In some instances the dried molds were pulled back, unloaded, set up and poured in the first bay. To meet this condition, the ladle was placed on a truck in the second bay and pulled over a track into the first bay.

Parenthetically it might be mentioned at this point that molten steel from the furnaces in the second bay is conveyed in a similar manner to a section of the foundry located at one end and at right angles to the main building. Part of the floor space in this *L* is devoted to the production of miscellaneous castings in green sand molds. The remainder of the section is fitted up specifically with molding machines, conveyors and a sand handling system for the production of side frames and bolsters also in green sand molds. The company also operates an iron foundry where the metal for chilled and sand rolls is melted in cupola and air furnaces.

Returning to the ovens between the two main bays of the foundry, one has been pulled down, two others stand idle as a result of adopting the new method of making molds. Two still are in use for drying cer- (*Please turn to page* 68)

Figs. 7 and 8—Miscellaneous cores on drying floors. Fig. 9—Cope and drag cores for pig machine molds. Fig. 10—Copes and drags for crosshead castings. Fig. 11—Crosshead molds in process of assembly

How Some Foundrymen Solved Their Problems

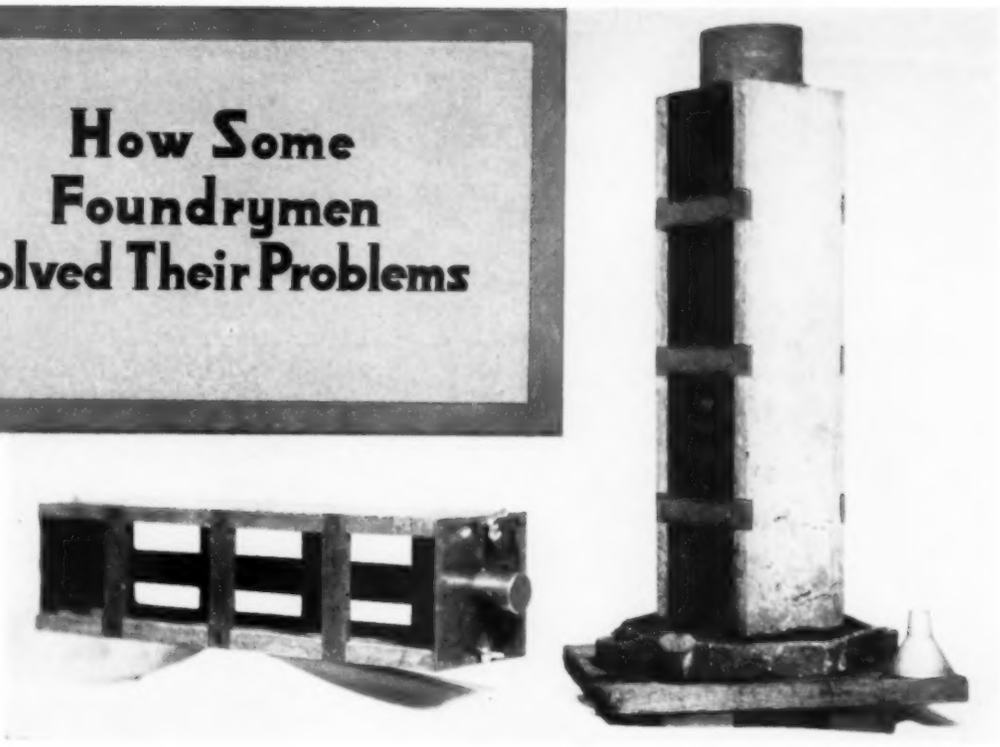


Fig. 1—Flask for the transverse test bar

Develops Aluminum Flasks For Producing Test Bar Molds

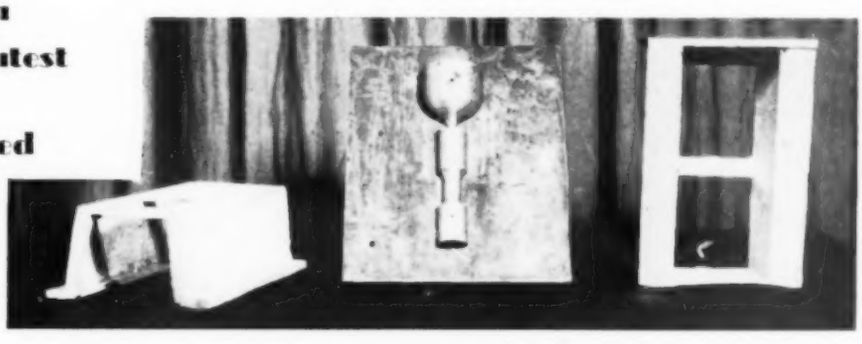
By Edward Grant
Kansas State College, Manhattan, Kan.

FLASKS shown in the accompanying illustrations were developed to facilitate the production of cast iron tensile and transverse test bars. The flask for the transverse bar shown in Fig. 1 is made up of two cast aluminum plate sides, six steel cross members and two steel end plates. The side plates are ⅜ x 4 x 18 inches. The six steel strips are 3/16 x 1-inch and are held by screws in recesses in the edges of the plates. Each steel end plate fits over two studs which project ⅜-inch and is held in place during the ramming operation by two wing nuts. A circular opening in the center of each plate admits the pattern for the test bar, a piece of steel shafting 20 inches in length. In this particular instance the test bar is to be broken on a machine with 12-inch centers.

In practice the operator adjusts the end plates and pattern in position. The flask is placed on a smooth, straight board or plate, filled with sand and rammed. The surplus sand is scraped off, the flask is turned over and the sand is rammed from the other side. No venting is needed. The pattern is withdrawn through the opening in the end plate to leave a perfect mold. The end plates then are removed. If desired, a number core may be inserted in one end of the mold. This number core is 1¼-inches in length, with a slight taper so that it may adjust itself to the mold and remain in place when the flask is turned up on end either on the floor, or in a small flask with a bottom board. A small pouring cup is placed over the upper opening. The pouring cup with a ⅝-inch diameter opening in the bottom is made in a short piece of 3-inch gas pipe over a conical aluminum pattern.

Flask and pattern for the tensile test bar are

Fig. 2—Flask and pattern for tensile test bar



Three Articles Receiving Honorable Mention in The Foundry's Award Contest

Others Will Be Presented In Early Issues

shown in Fig. 2. A half pattern is mounted as in ordinary practice on each side of the plate. One end of the tapered aluminum flask is closed, while the other end is closed by a steel plate as in the first instance. The flask is tapered on the sides and is provided with sand strips, or small internal flanges to carry the sand. After the mold is closed the plate is removed from the end of the cope and drag. The halves of the flask may be clamped or bolted together. It is then turned up on end and poured in the same manner as the mold for the transverse test bar.

Changed Design of Corebox To Speed Production of Tank Cores

By G. O. Ekstedt
Ekstedt Foundry Co., East St. Louis Ill.

ONLY a comparatively few years ago 14 tank heater cores constituted a good day's work for a coremaker. A casting loss of 50 per cent due to wet paste joints, improperly gaged cores or weak stopoffs was not unusual. With the equipment shown in the accompanying illustration, the usual production is 14 cores per hour. Casting loss traceable to the core practically is eliminated. The dome type core is shown, but the same method is applicable to other shapes.

This method and equipment recently developed by the writer produces a one-piece core, thus eliminating the necessity of rubbing the former type of half cores to a bearing, pasting the joints, puttying around the edges, and gagging the complete core for size. The green core is made in two half boxes as formerly, but the half cores are joined or *booked* to form a complete core before the core is placed in the oven. The plate *D* with a raised semicircular rib on the face is used to form a vent passage at the joint line of the two half cores. It simply is pressed into place and removed. This vent passage coincides with the vent opening in the stopoff branch core shown at the left of the main core in Fig. 1. After the dried core is removed from the oven the coremaker tests the opening with a wire to see that the passage is clear.

In making the core the two half coreboxes are filled with sand, rammed, struck off flush, vented and booked with the part *C* on top. The punch *E* is inserted through a hole in the box to form a seat for the small core at the side. The inner ring is withdrawn and replaced by the dryer shell *A* and then the box is turned over and the upper part of the box *B* is removed. One of the branch cores, dried in advance is attached to the main core. The end of this core enters the print in the main core and the stopoff part rests on an extension to the dryer shell. In this manner the dryer shell serves as a gage as well as a support. The branch core is anchored solidly and becomes an integral part of the main core.

Fig. 1—(Top), The core with stopoff branch in place. Fig. 2—(Bottom), Core making equipment including dryer shell A, upper half B, lower half C, vent plate D, punch E and stopoff corebox F

Investigation Shows Actual Cupola Melting Loss and Gain

By J. A. Lanigan
Cincinnati

DISCUSSIONS on actual cupola melting loss or gain frequently appear. What is the difference in weight between iron charged into the cupola and iron as melted, delivered at the spout, plus all iron salvaged from the cupola drop? Figures representing this difference of course properly would be charged to cupola melting loss or gain; as the case might be.

This old question still is a puzzle to foundrymen and especially to all interested in actual facts and figures relating directly to the question. Foundry scrap, made up of gates, spills and bad castings too often is confused with the cupola melting loss or gain. Spilled iron and bad castings are not even remotely related to the problem.

Generally, when a foundryman gets interested in the matter of losses, he consults text books on foundry practice, some written by practical men, some by theorists and others by men trained in related subjects. Usually he finds himself tangled in a maze of opinions and contradictory matter, all of which gives nothing positive on the subject. This lack of positive information has been caused by a lack of financial aid in securing the necessary equipment to carry on foundry operations on a sufficient scale and devoted exclusively to the securing of correct information on cupola operation and actual melting losses (*Please turn to page* 72)

Fig. 1—Molder placing tubes in mold cavity. The metal block holds the ends of the tubes in position and forms a chill to protect the openings in the ends of tubes

FORMED TUBES CAST IN GRAY IRON

CASTING formed tubes for use as electric immersion heaters inside of a protective coating of gray iron requires special molding methods and precautions to keep the moisture at a minimum. Such castings are made for use in maintaining type metal in molten condition in newspaper plants, etc.

The formed tubes are seamless and enclose resistance wire insulated with magnesium oxide. Fig. 1 shows a molder at the Cleveland Works of the Westinghouse Electric & Mfg. Co. placing the tubes in the mold cavity. Metal straps welded to the tubes hold them in place while the mold is filling with molten iron. The metal block, which the molder is holding in his right hand, serves the double purpose of holding all (six in this case) the ends of the tubes in their proper position and forming a chill to protect the open ends of tubes and prevent the metal from shorting the tube and resistance wire.

The tubes are checked for dimension and location of supporting straps or chaplets. They are then sandblasted carefully to make sure of clean surface. Next they are dipped in aluminum paint (lacquer base) and allowed to air dry for 30 minutes or more. They are then placed in a drying oven maintained at a temperature of 400 degrees Fahr., for an hour. This last step is to remove all moisture that might cause trouble when the mold is filled with molten iron.

The tubes are handled warm, set in the mold, closed and poured as quickly as possible. It has been found that iron 2450 to 2500 degrees Fahr. gives best results. Pouring temperature is checked with an optical (*Please turn to page* 75)

Fig. 2—The tubes are handled warm, set in the mold, closed and poured as quickly as possible

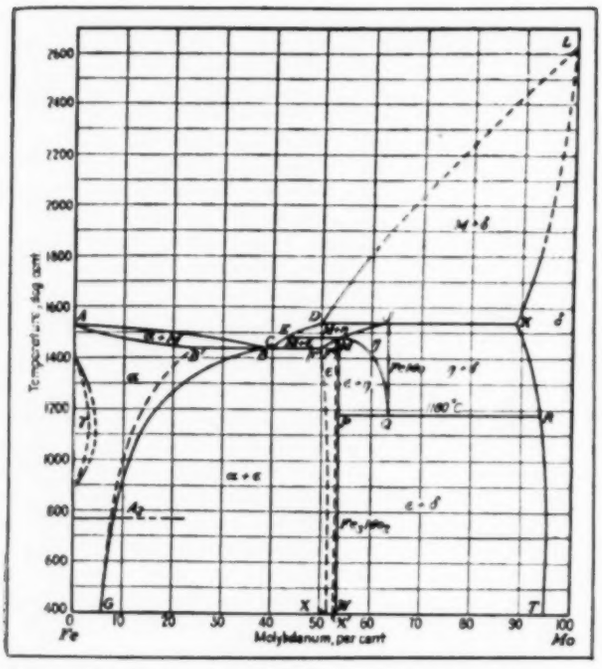


Fig. 85—The iron-molybdenum equilibrium diagram constructed by Gregg from data from Sykes and from Takei and Murakami

GRAY CAST IRON

By JOHN W. BOLTON

Chapter VI (*Continued*)

THE metallic element molybdenum has the following properties: Atomic weight 96.0; melting point 4750 degrees Fahr.; density at 20 degrees Cent. 10.2 and brinell hardness 147. The high melting point and high density are noteworthy.

Molybdenum forms a carbide Mo_2C, containing 5.88 per cent carbon*. The crystal structure is hexagonal close packed. The calculated density is 8.91. There also is a ternary carbide, apparently Fe_4Mo_2C found in iron-molybdenum carbon alloys.

Pure iron at room temperatures is capable of holding about 6 per cent molybdenum in solid solution, (alpha-phase). The iron-molybdenum diagram, constructed by Gregg from data from Sykes and from Takei and Murakami is shown in Fig. 85, taken from *The Alloys of Iron and Molybdenum*—Alloys of Iron Monograph. Generally speaking addition of small percentages of molybdenum (under 1 per cent) probably has little effect on the mechanical properties of pure iron.

The molybdenum-carbon digram according to Takei is shown in Fig. 86. As is evident from the dotted lines, much of the diagram has not been established fully. The solid solubility of carbon in molybdenum is about 0.3 per cent. Within the range from 0.3 to about 4 per cent carbon, the alloy consists of this solid solution and of an eutectic of molybdenum and the carbide Mo_2C. From 4 to 5.5 per cent the carbide and the eutectic are present. From 5.5 to 5.9 per cent carbon a single phase, largely the carbide Mo_2C, is present. It is interesting to note that above 5.9 per cent some free graphite is precipitated.

Takesi Takei—*Kinzoku no Kenkyu*, vol. 9, pages 97-124 and 142-173, 1932—has studied 156 alloys covering this system, and obtained data from which the ternary diagram has been established. In Fig. 87, taken from *Alloys of Iron and Molybdenum*, a section of this diagram at 2.0 per cent molybdenum is shown.

The following symbols indicating the various phases:

α—Solution of carbon and molybdenum in alpha iron.

γ—Solution of carbon and molybdenum in alpha iron.

C—Iron carbide, cementite (plus dissolved C, Mo and Fe).

ω—Double carbide of Fe and Mo.

L—Liquid or molten metal.

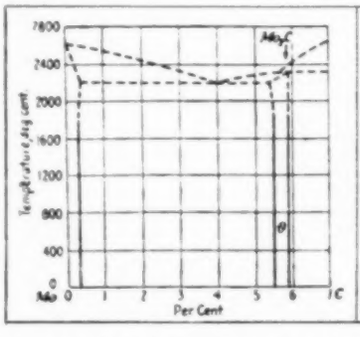
Comparison with the iron carbon diagram shows that:

1—The temperature of eutectic solidification of iron carbon alloys is not materially changed by molybdenum additions.

2—The percentage of carbon required for the eutectic is approximately the same as that of the pure iron carbon alloys.

3—The temperature of the eutectoid transformation is about the same as that of the pure iron carbon alloys.

4—The eutectoid percentage of carbon is low-



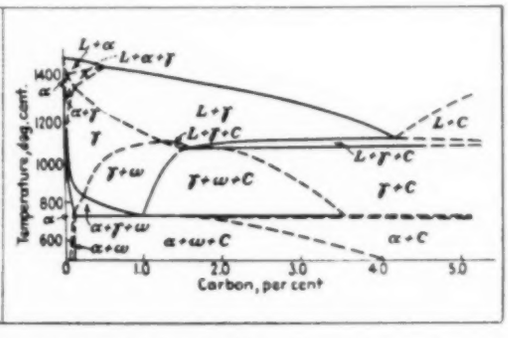


Fig. 86—Molybdenum-carbon diagram according to Takei. Fig. 87—Section of ternary diagram at 2 per cent molybdenum

ered about 20 points for each per cent of molybdenum. This is not as shown on Fig. 87. However, the work of Reed—*Transactions*, American Society for Steel Treating, vol. 20, pages 115-174, 1932—and of Swinden—*Carnegie Memoirs*, vol. 3, pages 66-124, 1911—as plotted by Gregg, indicate it as in Fig. 88 from *Alloys of Iron and Molybdenum*.

5—A new constituent, the double carbide (ω) is found both above and below the eutectoid transformation.

6—There is no graphitization shown in the iron-molybdenum-carbon series at carbon percentages below the eutectic concentration.

Although molybdenum is a carbide forming element, amounts up to 2 per cent apparently do not inhibit graphitization markedly,—Cournot and Challansonnet—*Comptes Rendus*, July 4, 1932, pages 46-48.

Much depends on the rest of the composition of the iron and the size of the section. Addition of less than 2 per cent molybdenum to a borderline iron might produce chill spots. Conversely, it is probable that well over 2 per cent molybdenum could be added to a high silicon, high carbon iron with no chill resulting.

Molybdenum has an appreciable refining action on the graphite flakes, causing them to assume a somewhat more compact formation than is usual in molybdenum free irons of otherwise similar composition.

Although small amounts of molybdenum do not change materially, the amount of combined carbon, the normally pearlitic structures are refined, not infrequently approaching a sorbitic condition. Also less combined carbon is necessary for an eutectoid matrix.

The effects on graphite flake formation, on the structure of the matrix, and on the concentration of combined carbon required for the eutectoid suggest that molybdenum additions should have a strengthening effect on cast irons.

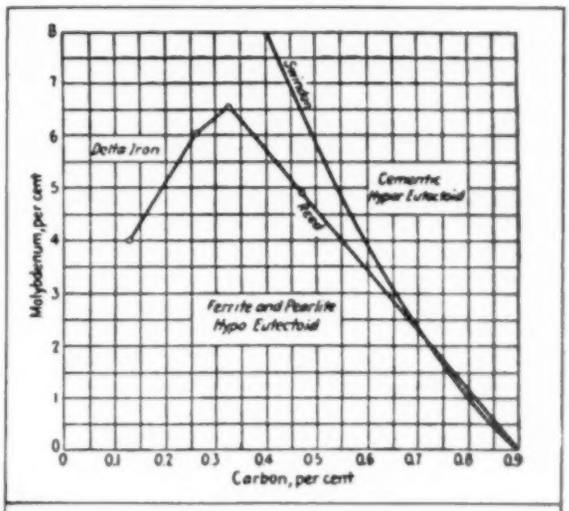
This is indicated in Table VII. Molybdenum additions beyond 1.5 per cent seem of little value in increasing strength, although brinell hardness is increased and machinability decreased This is shown in Fig. 89, from the *Symposium on Cast Iron*. When added to suitable base irons, molybdenum is considered the most effective strengthening alloy element in common use.

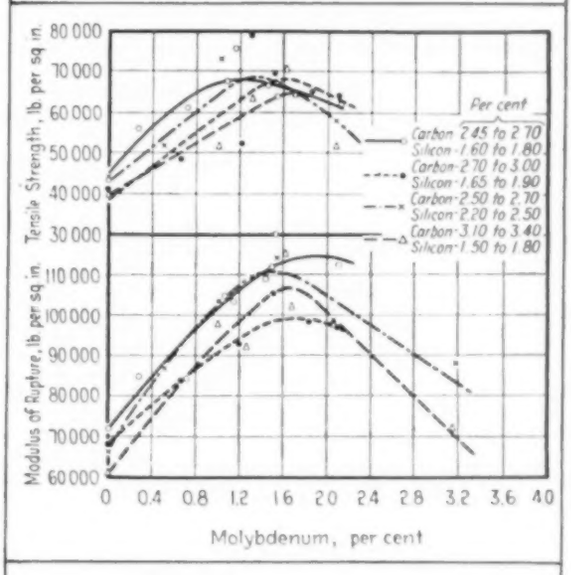
The fact that molybdenum hardens and densens the structure of the matrix indicates that under some conditions molybdenum will materially increase wear resistance. This is indicated by the successful applications of molybdenum bearing irons in automotive brake drums, cams, dies, etc.

Using an Amsler wear testing machine Musatti and Calbiani found that under the conditions of the test and on the base iron they were working with, additions of 1.5 per cent molybdenum decreased the wear to one sixteenth what it was on the non-alloyed base iron. This of course is a special case, not necessarily representative of commercial practice.

It is claimed by producers that molybdenum additions increased the impact resistance. These claims are based on general experience and the increases in strength and deflection observed when molybdenum is added.

In increasing (*Please turn to page 70*)




Tensile Strength, lb per sq in.
Modulus of Rupture, lb per sq in.
Molybdenum, per cent
Per cent
Carbon 2.45 to 2.70 Silicon 1.60 to 1.80
Carbon 2.70 to 3.00 Silicon 1.65 to 1.90
Carbon 2.50 to 2.70 Silicon 2.20 to 2.50
Carbon 3.10 to 3.40 Silicon 1.50 to 1.80

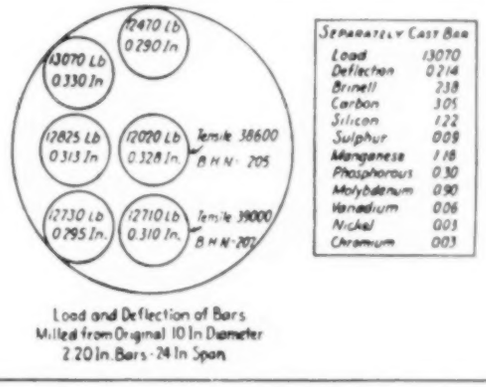
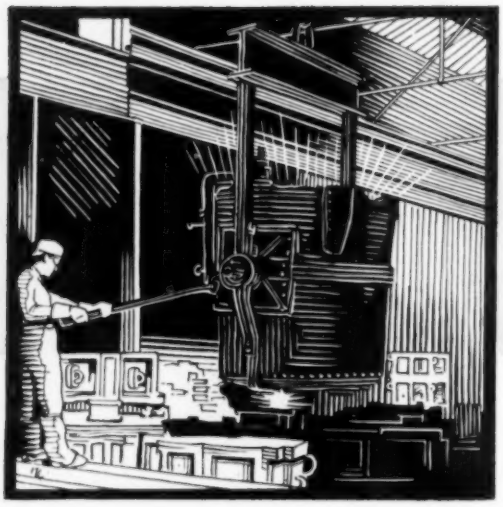


Fig. 88 (Above)—Eutectoid concentration curve of molybdenum steel. Fig. 89 (Center)—Effect of molybdenum on strength properties, according to Musatti and Colbiani. Fig. 90 (Below)—Properties of molybdenum cast iron as influenced by size of section, according to MacKenzie



Questions and Answers

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions from subscribers addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the advisory staff.

Cold Iron May Be Cause Of Defects in Bath Tub Casting

We pour our apron tubs through three runners, one at each end and one in the center of the apronless side. Some of the castings show a defect known locally as a dimple about half way between the top and the bottom on the apron side. This dimple is a scar on the face and usually is accompanied by a thin place on the casting. According to one opinion this is caused by dull iron, but although the dimples are plentiful, the missruns are scarce. Do you think that a steam condition may be responsible?

The evidence submitted seems to indicate cold iron, but without a knowledge of the pouring temperature of the iron it is impossible to say whether the iron is too cold when it leaves the ladle, or, receives a chilling effect after it enters the mold through hard or extra damp sand. A possibility exists that the sand and iron are satisfactory, but the mold is not filled rapidly enough. In that case it may be necessary to introduce some of the metal through an additional runner on the apron side of the tub.

Cupola May Be Banked For Many Hours if Necessary

The practice of banking blast furnaces over long periods seems to be quite satisfactory. Has any person ever tried banking a cupola, and if so, with what success?

Theoretically it is just as feasible to bank a cupola as it is to bank a blast furnace. However, in actual practice the operating conditions are widely different. Economic conditions that suggest the advisability of banking a blast furnace are not present in a foundry, hence there is nothing to be gained by voluntarily banking the cupola.

Occasionally instances arise where the operation of the cupola has to be suspended for some time. Possibly by stretching the actual meaning of the term, one of these periods might be termed a banking period and may extend from 1 to 12 hours. Possibly also the period of rest might be extended beyond 12 hours, but we have no record of any cupola held for any longer period. In foundries where cupolas are operated continuously the usual practice is to shut off the wind for an hour at the lunch period. Occasionally in the average foundry where the heat may run from 1 to 4 hours, an involuntary shut down may be caused by any one of many reasons, usually a break down in the blowing equipment. The practice then is to drain the cupola, and close all the air inlets until repairs are effected.

Chill Coating Is Not Cause of Rough Face on Casting

We chill an area 5 x 15 inches on some of our gray iron castings. This area presents bulls eyes, seams and other irregularities. Can you suggest a suitable coating for the chills that will produce a smooth surface corresponding to the smooth surface on the remainder of the casting?

Occasionally the coating on the chills may be responsible for the defective surface on the face of the castings. However, in the majority of instances the defect is due to the temperature of the metal and the speed of pouring. Where the metal is cold and advances slowly over the chilled face it cools in ridges, waves or whorls and succeeding metal flows over these ridges. This form of defect is accentuated where the metal enters the mold through several gates. Unless the metal is very hot and unless the stream advances very rapidly, the tips of the streams solidify in ridges. The remedy is

to cover the face of the chill rapidly with hot iron.

The primary reason for coating a chill is to prevent the surface from oxidizing. An oxide scale is converted to gas by the heat of the iron and will produce blowholes in the casting. A second reason for coating a chill is to preserve the surface and prevent the casting from adhering. The chills of course must be clean and perfectly dry. Any dampness or rust will cause the iron to flutter in the vicinity and result in a rough surface.

The coating usually employed is a thin film of graphite or other carbon blacking. This is mixed with a weak solution of molasses water and applied as a wash. The wet chills then are dried in the oven. In many instances it is sufficient to spray, rub or brush a thin coating of oil on the face of the chill. Practically any kind of oil will serve. This comment probably is sufficient for your present purpose. In the event that you are further interested in this and other related phases of the subject we recommend a new book *Gates and Risers for Castings* which describes the causes and remedies for practically every type of defective casting. The book may be purchased through THE FOUNDRY.

Dirt Found on the Face of Wheel Enters the Mold with Iron

On an 18-inch solid web chilled tread car wheel we find streaks of dirt on the face of the tread opposite the web. We have tried casting this wheel flange up and flange down. We have poured through a basin and pop gates on top of the hub, and through a sprue in the center of the core leading to small gates at the bottom of the hub.

Either type of gate is satisfactory provided all the passages are perfectly clean and the metal does not wash any sand from the walls. The wheels may be cast either flange up or flange down. Small wheels usually are cast flange up, while the universal practice on large wheels is to cast them flange down.

Touching first on the cause of the dirt, it may be slag from the ladle. It may be sand washed from the basin, sprue or gate passages. It may be loose blacking carried along by the stream of iron. It may be a slushy compound formed by the iron boiling from a wet or hard mold, or from a damp chill. It may be that the chill coating is applied too thickly and some of it washes from the face. A careful check of these features will show which is responsible.

The iron flowing from the hub and over the web fills the rim and the dirt floats up as high as a point opposite the web. At this point the upward movement is arrested since the remainder of the metal entering at this level simply flows upward in the rim and leaves the dirt sticking to the chill. Faster pouring through larger gates and sprue might carry the dirt to the top of the rim, but that is not a satisfactory solution for the present problem. The proper remedy is to prevent the entrance or formation of this foreign material.

Colloidal Graphite May Lubricate at High Temperatures

We make a rotating valve using two iron parts. We have been using a graphitic iron for one part as opposed to an oil impregnated iron on the other. The part is submitted alternately to a heat of around 350 to 400 degrees Fahr. and then cooled slowly to room temperature. There is a question in our minds on the ability of the oil to stand up under the heat.

Presumably you refer to soft gray iron with most of the carbon in the graphitic state. Irons of that nature possess self lubricating properties due to the presence of the large graphite flakes. Higher quality irons due to the presence of graphite in a much finer state of subdivision, and of course, less carbon in the form of graphite, are much lower in lubricating quality. Hence, oil, etc. is needed to get the best results.

As far as the oil impregnation you mention, we doubt whether the oil will stand up. It is our impression that the oil will not stand up under such temperatures as you mention, but for definite information it is suggested that you communicate with some large oil firms.

It occurs to us that you might be able to overcome your difficulties through the use of colloidal graphite suspended in oil — or water — for lubrication of the valve. Even though the carrying agent (oil or water) disappears, the graphite is deposited and will function as a lubricant, even under temperatures considerably higher than you mention.

Interesting installation of cylindrical unit for refining molten iron with purite. Photograph courtesy Mathieson Alkali Works

Alloys May Absorb Sulphur During Melting

We are having difficulty obtaining sound castings made of an alloy containing 60 per cent nickel and 40 per cent copper. The alloy is used for valves (clacks) and seats for valves up to 2 inches in size, and a large percentage of them are porous. We are casting them in the usual way with extra large heads. How can sound castings be produced that will withstand a hydraulic pressure test?

Alloys high in nickel have a tendency to absorb sulphur and other gases of combustion during melting, due to the high temperature at which they are melted. If the furnaces used are slow melters, more trouble will be encountered than in furnaces which melt rapidly. Hence, one of the first things to do, is to see that rapid melting is obtained.

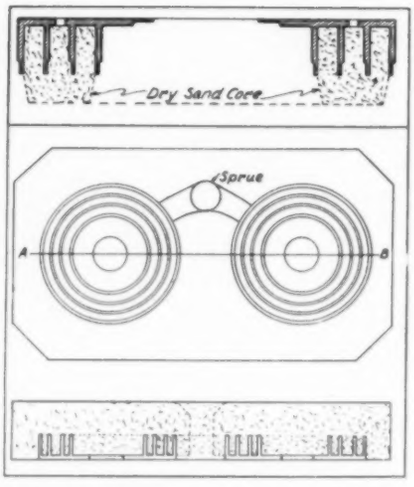
Then check the amount of time that the metal is held in the furnace after it reaches the point where it can be poured properly. The longer the metal is permitted to stew in the furnace, the more gas it will absorb. You do not mention whether you are employing any deoxidizing agent. If not, we believe that addition of 1½ ounces of metallic magnesium just before pouring may eliminate the porosity. Magnesium should be added as a piece of the proper weight, held in iron tongs, or a graphite phosphorizer, plunged beneath the surface, and stirred around in the metal. Permitting the magnesium to burn on the surface does no good. Investigate the fuel to see that its sulphur content is as low as is possible to obtain.

Mold Oil Burner With a Core in the Cope

We will appreciate your advice on the method and equipment required to turn out good burner castings for oil ranges. The casting is flat on one side and carries three deep grooves or channels on the opposite side.

For experimental or exhibition purpose, or as a test of skill, this delicate casting might be made in a green sand mold, but on a commercial basis the hazard is too great. In actual practice the face side of the casting, that is the side containing the channels for the wick, is formed in a dry sand core. Some foundrymen limit the application of the dry sand core to this particular part of the casting and form the remainder of the mold in green sand as shown in Fig. 1.

The core is formed from an oil sand mixture and is a tight fit in the drag print. Thus when it is pushed down into place, it will remain without either anchors or chaplets. Usually the vent will pass freely through the drag. Where the sand is *closer* than usual, a few holes made with a vent wire will insure a clear passage for the gas from the core. Two, or in some instances four patterns are mounted on a plate and the four molds are gated at the joint from a single sprue.



Above—Casting made in drag. Below —Made in the cope

In a second method, shown in Fig. 2, the entire casting with the exception of the flat face, is molded in a dry sand core which also forms the cope of the mold. Sprue and gates also are formed in this core which later is placed on the flat face of a green sand drag. Usually the castings are molded and cast in pairs. Manifestly a fine grade of core sand is required to impart the desired smooth surface. Also the permeability must be high to permit the ready escape of gas. Of course this feature is not so hazardous as in the first example where the core is placed in the drag.

The two patterns are placed in the bottom of a 10 x 18-inch corebox—which merely is a plain frame —2 inches deep with a set gate and sprue as shown in the top view Fig. 2. The core box then is filled with sand and rammed in any convenient manner, by hand, or on a jolt or squeeze machine, preferably on a jolt machine. The core and corebox are rolled over on a suitable plate and the corebox is removed, thus leaving the core on the plate with the impression of the two patterns on the upper side. After the core has dried it is inverted and placed on a plain, flat green sand drag. A weight is placed on top as in ordinary snap flask practice and the iron then is poured into the mold. Unfortunately the core serves only for one pair of castings and thus increases the cost to some extent.

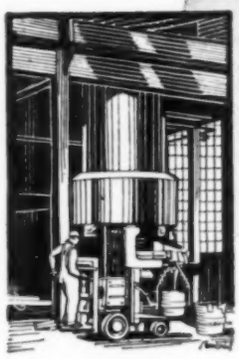
Many Precautions Needed on Bronze Tablet

We are having some trouble with rough spots on the face of tablets poured in green sand molds from an 85, three-5 bronze mixture. If it is necessary to dry the molds please outline the procedure and the materials employed.

Many small tablets are cast successfully in green sand molds, but the greatest care is required in preparing and ramming the sand. If the sand is too dry it will wash under the metal. If it is too wet or too hard the steam will lift particles off the face, particularly the small projecting bodies of sand in the letters. If the sand is rammed too soft the casting will swell in the mold and exceed the required thickness. Due to the limited thickness of medium size and large tablets the metal must be poured at a high temperature and at high speed.

To avoid all these hazards, foundrymen have developed the almost universal practice of skin drying the face of the mold. Any water soluble binder will serve, but molasses water usually is employed. The strength of the solution is about 1 to 20, one part molasses to 20 parts water. In rough and ready shop practice this works out as approximately 1 pint (by guess or measurement) to one 2½ or 3-gallon pail of water. After the pattern has been removed from the drag, the face of the mold is covered with a coating of plumbago shaken through a bag. This is followed by a light dusting of lycopodium, charcoal dust or other drying medium.

The pattern then is replaced in the mold and rapped down all over. In stove plate and other shops of a somewhat similar character this practice is known as *printing back*. The pattern again is removed and the face of the mold is sprayed with molasses water. The amount of spraying will depend on the thickness of skin desired to be dried. This will vary from ⅛-inch on small tablets to ¾-inch on large tablets. However, on large tablets it is customary to incorporate a small amount of core binder in the facing sand, instead of depending altogether on the spraying process. Any one of a number of methods may be employed to skin dry the face of the mold. Usually a few bricks are placed on the joint to support one or more pieces of thin sheet steel. A charcoal fire is built on these sheets and maintained until the sand has dried to the required depth. Actual experience is the only guide in determining this point. Care must be observed in distributing the fire to maintain a uniform heat over the entire face of the mold.



Viewing Foundry Developments . . . AT SHORT RANGE

SPECIAL tiles with openings either at the sides or ends are used extensively for sprues and gate passages on molds for large iron and steel castings. In addition to their convenience they insure a clean passage for the metal. They remove a certain hazard where sand carelessly rammed around the sprue or gate, will crumble away and flow into the mold with the molten metal.

♦ ♦ ♦

According to a recent patent, manganese will prevent segregation of lead in high-lead, copper-base bearing alloys. The range covered includes 10 to 30 per cent lead; 1.5 to 7 per cent manganese; 1 to 6 per cent tin, and up to 1 per cent phosphorus. The preferred composition is given as 20 per cent lead; 1.5 per cent manganese; 4.7 per cent tin; 0.3 per cent phosphorus, and 73.5 per cent copper.

♦ ♦ ♦

AFTER trying various mixtures, a manufacturer of sugar mill rolls found the most satisfactory rolls are made from a basic high phosphorus pig iron. The finished surface on the rolls has a rough texture which prevents slippage of the cane. The castings are allowed to cool and become self annealed in the molds. Analysis of the pig iron is approximately: Silicon 0.80 per cent, phosphorus 0.80 per cent, manganese 0.50 per cent and sulphur 0.05 per cent.

♦ ♦ ♦

In burning a piece on to a broken iron casting, only a soft grade of iron should be used. Low silicon irons do not knit as readily as irons with a fairly high silicon content. The second essential is hot iron. Through a suitable flowoff the iron is kept flowing in a shallow stream over the broken surface until the operator with a small bent rod feels that the casting surface is soft. The flowoff opening then is closed and the remainder of the mold space is filled with iron. If the casting can be raised to a red heat in advance, the amount of iron required to form the weld will be materially reduced. In some instances the casting must be heated in advance to prevent it from cracking, either during or after the operation.

♦ ♦ ♦

PREPARATION of high chromium ferrous alloys with low carbon content is accomplished through the use of silicon, followed by a violent agitation with an oxidizing slag to remove the silicon. The patent mentions a slag containing 30 per cent Cr_2O_3; 7 per cent Al_2O_3; 46 per cent CaO; 3 per cent SiO_2; 7 per cent FeO, and 7 per cent MgO. Violent reaction is obtained by pouring the molten metal from a height into the molten slag.

♦ ♦ ♦

Where power bills are based on a peak demand charge, an eastern steel foundryman has reduced expense by melting and pouring his metal at night when other activities are fairly quiet.

♦ ♦ ♦

Cylinder sleeves produced of a special grade of iron which has been nitrided on the bore surface, has the following analysis: Total carbon, 2.93 per cent; graphitic carbon, 2.31 per cent; combined carbon, 0.62 per cent; phosphorus, 0.058 per cent; sulphur, 0.029 per cent; manganese, 0.76 per cent; silicon, 2.69 per cent; chromium, 1.28 per cent; vanadium, 0.16 per cent; molybdenum, 0.24 per cent; aluminum, 1.01 per cent. Brinell hardness will be 800 to 1000 for a depth of 0.004 to 0.006 inches.

♦ ♦ ♦

Aluminum surfaces in various colors may be obtained by first providing an adherent oxide coating, and then treating that coating with various inorganic compounds according to a recent patent. The oxide coating may be obtained electrically in a 7 per cent sulphuric acid or 3 per cent chromic acid solution, or without electricity in a boiling bath containing 2 per cent sodium carbonate and 0.5 per cent potassium dichromate. Brown color is obtained by immersing in potassium bichromate followed by immersion in silver nitrate. Dipping first in uranyl acetate and then in potassium ferrocyanide gives red while yellow is obtained by dipping in cadmium acetate followed by ammonium sulphide. Numerous other colors are produced with other reagents.

♦ ♦ ♦

Occasionally a customer comes to a small jobbing shop with a broken, warped or partly burned casting for which there is no pattern. Where the job does not warrant the expense of making a regular type pattern, the foundryman makes a mold off the old casting. The mold is filled with lead, which afterward easily is cut, filed, and hammered to the proper shape to serve as a pattern.

♦ ♦ ♦

ELIMINATION of a chilled surface on centrifugally cast pipe made in metal molds can be accomplished by using two layers of metal. As described in the patent,

the first layer is composed of iron containing 3.0 to 4.5 per cent carbon and 6.0 to 2.5 per cent silicon. The second layer of iron which is poured immediately after, contains 2.5 to 3.5 per cent carbon; 1.0 to 1.25 per cent silicon; 0.5 to 2 per cent manganese, and 0.3 to 1.5 per cent phosphorus. Both layers fuse together eliminating chill, line of demarcation, and provide a strong pipe.

H. E. Field

H. H. Judson

F. E. Fisher

Men of Industry

H. E. Field, for the past 5 years vice president, Mackintosh-Hemphill Co., Pittsburgh, has resigned to become vice president, Continental Roll & Steel Foundry Co., with headquarters in Pittsburgh. Mr. Field has been identified with the production and sale of iron and steel rolls and castings since his graduation from Worcester Polytechnic institute in 1895. For four years he was assistant to the superintendent, Builders Iron Foundry, Providence, R. I., and later served as metallurgist, Farrel Foundry & Machine Co., Ansonia, Conn. He went to Pittsburgh in 1904 to become superintendent of foundries for the Mackintosh-Hemphill Co., and continued that affiliation until 1914 when he became president of the Wheeling Mold & Foundry Co., Wheeling, W. Va. When that company, the Duquesne Steel Foundry Co. and the Hubbard Steel Foundry Co. were merged into the present Continental Roll & Steel Foundry Co. in 1930, he returned to Mackintosh-Hemphill Co. with plants at Pittsburgh and at Midland, Pa.

Theodore E. Palmer recently was made asistant foundry superintendent, Gilbert-Barker Mfg. Co., West Springfield, Mass. Mr. Palmer graduated from Wentworth institute, Boston, in 1918 and immediately entered the employ of the Brown & Sharpe Mfg. Co., Providence, R. I., remaining until 1922 when he was made foundry superintendent, Wilcox, Crittenden Mfg. Co., Middletown, Conn. In 1923 he was made foundry superintendent for the Old Colony Foundry Co., East Bridgewater, Mass. and remained at that organization until his recent appointment.

F. E. Fisher, for the past 2 years metallurgist with the Western Foundry Co., Chicago, has become associated with the Sloss-Sheffield Steel & Iron Co., Birmingham, Ala., in the Chicago and St. Louis sales offices. Mr. Fisher also was foundry adviser for the Bethlehem Steel Co. for 9 years, covering the middle western and eastern states. His earlier training and experience in the foundry industry was gained through connections with the Curtis Mfg. Co., and the Green Foundry Co., both of St. Louis. His headquarters will be at the Chicago sales office, 333 North Michigan avenue.

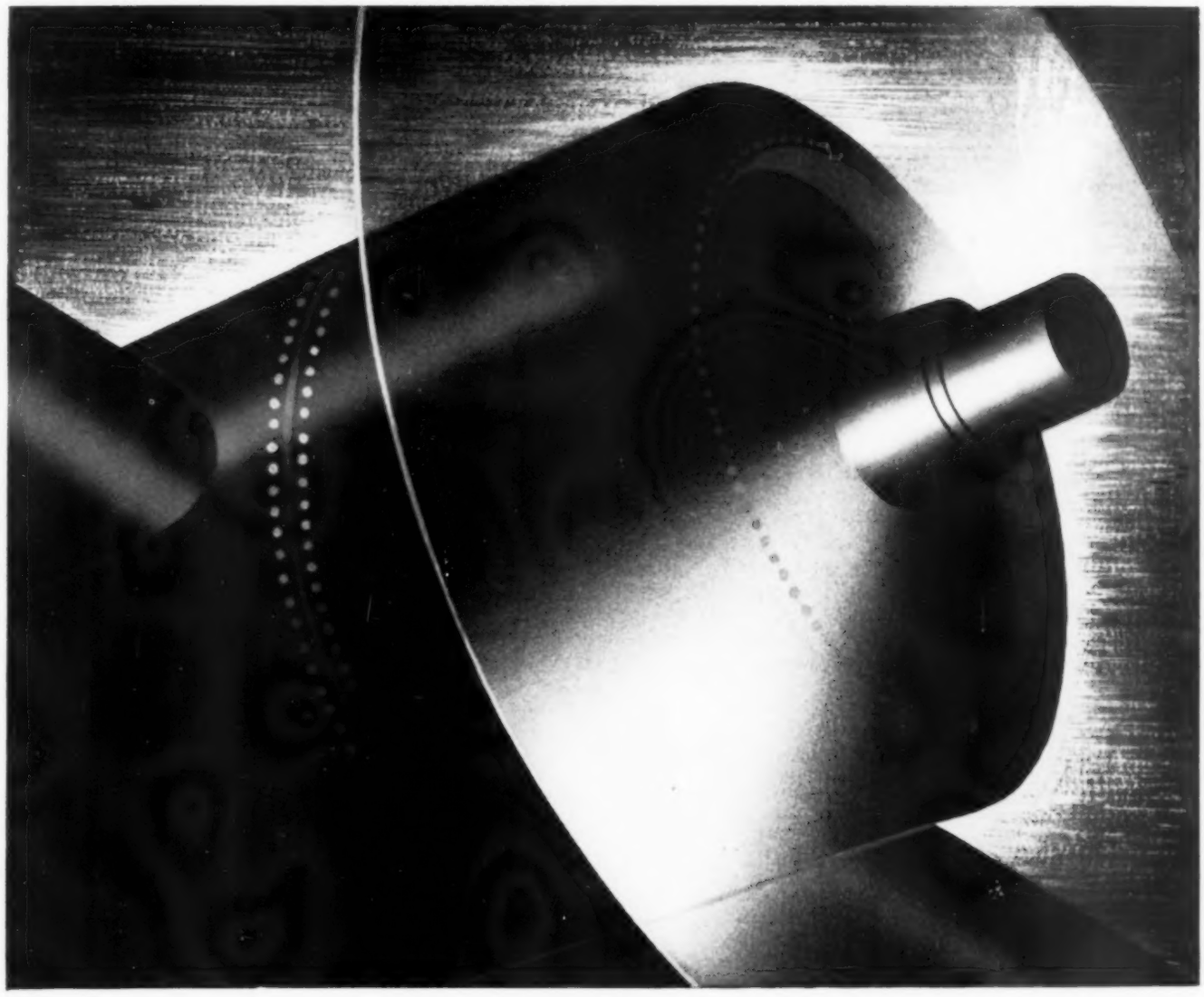
Lewis M. Lind, Cleveland, has been appointed acting chief, machinery division, bureau of foreign and domestic commerce, Washington, succeeding R. E. W. Harrison who recently resigned. Mr. Lind assisted in the administration of machinery codes when NRA was in effect. He formerly was associated with the foreign trade department of the Cleveland chamber of commerce, the Malleable Iron Research institute and the Lake City Malleable Co., Cleveland.

Gen. Thomas S. Hammond, president, Whiting Corp., Harvey, Ill., was elected president of the Illinois Manufacturers association at its annual meeting in Chicago, Dec. 10. Other officers elected include: First vice president, G. P. Torrence, president Link-Belt Co., and second vice president, C. B. Heacock, president Caterpillar Tractor Co., Peoria, Ill.

Harold H. Judson, foundry superintendent, Gould's Pumps Inc., Seneca Falls, N. Y., will be the author of the annual A.F.A. exchange paper to be presented at the annual meeting of the Institute of British Foundrymen in 1936. Mr. Judson was born in Holyoke, Mass., and was graduated from Worcester Polytechnic institute in 1923, receiving a bachelor of science degree in mechanical engineering. During the following three years he was foundry engineer with the Riley Stoker Co., Detroit, and in 1926 became connected with Gould's Pumps Inc. as foundry superintendent.

The Institute of British Foundrymen and the A.F.A. initiated the annual exchange of papers in 1921. Originally started to present reviews on developments in foundry practice

(*Continued on page* 44)



MOLY makes better surface-hardening steels

It would be difficult to find a better test of surface-hardened steels than in airplane engines. Cylinders, knuckle pins, propeller shafts, crankshafts and various gears are subjected to particularly severe service. . . Hence the large number of instances in which such parts are made of Molybdenum surface-hardened steels.

There are also many other applications, outside the airplane field, in which the outstanding quality of "Moly" surface-hardened steels to meet the hardest of service requirements has been demonstrated over and over. Whether the process is carburizing or nitriding, the results are the same — and are dependent on the Moly content.

The practical reasons are easily explained. . . Moly increases the speed of penetration and gives a deeper, harder case. The core physical properties are exceptionally good, and there is no susceptibility to temper embrittlement. Distortion on quenching is slight — and uniformly predictable.

Moly cuts costs . . . It reduces the processing time in surface-hardened steels; lowers the rejection percentage. Moly improves steel . . . It makes it stronger, tougher, more resistant to wear, creep, corrosion. Moly creates sales . . . It makes a more serviceable, longer-lasting, more satisfactory product.

A more detailed account of "industry's most modern and versatile alloy" is given in our interesting technical book, "Molybdenum," which is yours for the asking. And, "The Moly Matrix," published periodically, will keep you informed on the latest Moly developments. Shall we put you on the mailing list? Climax Molybdenum Company, 500 Fifth Ave., New York.

CUTS COSTS CLIMAX Mo-lyb-den-um CREATES SALES

MOLY

(*Continued from page* 42)

between the two countries, the movement led to the formation of an international foundry committee composed of representatives of foundry technical associations in the leading countries of the world, including, in addition to the United States and Great Britain, France, Italy, Belgium, Germany, Czechoslovakia and Spain. Through that committee international foundry congresses are held every three years, the most recent being in Philadelphia in 1934. The next congress is scheduled for Dusseldorf, Germany in 1936.

H. T. ODENKIRK recently was appointed production manager, Keen Foundry Co., Griffith, Ind. L. E. Keen is president of the company.

G. G. VAN TUYL, 18927 Winslow road, Cleveland, has been appointed representative in Cleveland district by the Pennsylvania Pump & Compressor Co., Easton, Pa.

R. A. DONALDSON recently was appointed metallurgist, Woodward Iron Co., Birmingham, Ala. Mr. Donaldson was born in Birmingham and received his education in the public schools there and at the State Teachers college, Jacksonville, Ala. He began his metallurgical career in the chemical laboratory of the Woodward Iron Co. in 1921. Later he served in the research and also control laboratory of the U. S. Pipe & Foundry Co., Birmingham. In 1926 he was appointed metallurgist of that company at the Anniston, Ala. plant and continued in that capacity until the plant was closed in 1928. He then was appointed chemist and metallurgist, National Cast Iron Pipe Co., Birmingham, a division of J. B. Clow & Sons, and continued with that company until 1933. Since that time he has been connected with the Sloss Sheffield Steel & Iron Co., Birmingham, in sales and foundry consultant work. Mr. Donaldson will be occupied principally in foundry consultant work for the following representatives of the Woodward Company: Miller & Co., in the Chicago, St. Louis and Cincinnati territories and F. W. Marshall & Co. along the eastern seaboard.

R. A. Donaldson

E. S. CRANE, sales manager, has been made vice president in charge of sales, Cutler-Hammer Inc., Milwaukee. W. C. STEVENS, chief engineer, has been made vice president in charge of engineering.

RICHARD M. SMITH, formerly with Dodge Mfg. Co., and JEROME E. SWEET, formerly with American Foundry Equipment Co., both of Mishawaka, Ind., have joined the Claude B. Schneible Co., Chicago.

JAMES S. DUNCAN has been appointed general manager, Massey-Harris Co., Toronto, Ont., succeeding B. W. BURTSELL who has retired because of poor health. Mr. Burtsell remains on the board of directors and also continues as vice president.

B. H. WHITING has been appointed Cincinnati district manager of the Whiting Corp., Harvey, Ill., with offices at 705 Chamber of Commerce building. The Cincinnnati territory recently was enlarged to include southern Indiana, most of Kentucky, and southern Ohio up to and including Columbus. Mr. Whiting will handle sales for all the company's lines including electric traveling cranes, foundry equipment, railroad specialties, pulverizers and combustion equipment.

W. R. JENNINGS has been made foundry supervisor, Deere & Co., Moline, Ill., and will be connected with the tractor plant at Waterloo, Iowa. Mr. Jennings has had broad experience in the foundry industry. He first entered the castings field as representative of the Pittsburgh Testing Laboratory stationed at the Industrial Works, Bay City, Mich. In 1919 he became superintendent of the Bay City Foundry & Machine Co., and in 1925 was appointed foundry manager of the Baker-Perkins Co. Inc., Saginaw, Mich. From 1930 to 1934 he was foundry manager of the Frank Foundries Corp., Moline, Ill., and from then until the present was foundry manager, Ecorse Foundry Co., Ecorse, Mich.

L. D. SMITH has been elected vice president of Union Steel Castings Co., Pittsburgh, effective Jan. 1, to assist D. V. SHERLOCK, vice president and general manager, in the extension of sales. Mr. Smith is also vice president of Lewis Foundry & Machine Co., Pittsburgh. Both companies are subsidiaries of Blaw-Knox Co., Blawnox, Pa.

DAVID C. ARTHURS has been elected president, Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill., succeeding R. K. Weber, who has retired. Other changes in personnel include the appointment of L. G. SEVER as executive vice president, H. H. CUST as vice president and secretary, G. C. BEISHLINE as vice president and plant manager, and OWEN HARVEY as treasurer and assistant secretary. STANLEY W. BUTLER was elected to succeed Mr. Weber on the board of directors.

CHARLES A. STROH, for 25 years employed as a molder by the Bethlehem Steel Co., Bethlehem, Pa., was retired on Dec. 1. Although he worked in the steel mill foundry for a quarter century, Mr. Stroh's career as a molder covers a period of 60 years. He started work at the trade at the age of 15 in Mauch Chunk, Pa., in a foundry owned by his uncle. In 1887 he went

(*Concluded on page* 46)

L. D. Smith

SEALED HEAT!

A new foundry necessity which enables distributing large quantities of metal over long periods of time.

How Nash Motors Co. uses Modern SEALED HEAT to more perfectly synchronize its pouring and molding operations.

1. Filling a Modern 1 ton Covered and Insulated Ladle from a reservoir ladle.

2. Not a sign of any escaping heat as the ladle is transported to the extreme end of the foundry.

3. Tapping off 500 pounds of metal from the Modern Insulated Ladle, which is held 30 to 45 minutes, and longer, and the metal taken from it as needed.

MODERN

Covered and Insulated Ladles
Lifetime Geared Ladles
Improved Bottom-Pour Ladles
Metal Pouring Systems
Crane and Monorail Systems for Metal and Mold Handling
Furnace Charging Cranes
Sand Conditioning Systems

Patented & Patents Pending
Dept. 118

MODERN EQUIPMENT CO.
PORT WASHINGTON, WIS.

MODERN EQUIPMENT CO.

(*Continued from page 44*)

to McKeesport where he was employed by the National Tube Works for two years and then went to Pittsburgh where he remained until 1905. There he was employed by the Penn Casting & Machine Co., American Locomotive Works and the Anchor Foundry & Machine Co. During most of that time he was foreman of foundries at those companies. Then he returned to Mauch Chunk and for 2 years ran the foundry in which he learned his trade. He then went to Allentown to become foreman of the Taylor Engineering Co., and in 1910 entered the employ of the Bethlehem Steel Co.

C. N. WHITE, foundry superintendent, Kelsey-Hayes Wheel Co., Detroit, recently resigned.

RAY S. FOX has become affiliated with the pig iron sales department of the Republic Steel Corp., with headquarters in Cleveland. He formerly was manager of the pig iron sales department of the Cleveland-Cliffs Iron Co., and more recently head of R. S. Fox & Co., pig iron broker located in Cleveland.

H. C. ARMIN has been appointed representative of the Michiana Products Corp., Michigan City, Ind., in the New England states and New York. His headquarters will be at 754 East Twenty-third street, Brooklyn, N. Y. The Michiana Products Corp. specializes in heat resistant and corrosion resistant alloy castings.

M. W. LINK will head the new division of research and development recently established by the Crane Co., Chicago. Mr. Link will be assisted by B. A. PARKS and specialized work will be in charge of A. M. HOUSER, engineer of standardization; C. A. OLSON, research engineer, industrial and heating products; R. H. ZINKIL, research engineer, plumbing products; J. P. MAGOS, testing engipeer, research testing laboratories; and J. O. LANGE, engineer of patents.

Mr. Link became assistant superintendent of the company's New York pipe fabricating shops in 1901, and was construction engineer during the building of the firm's plant in Bridgeport in 1904. Later he became chief draftsman and mechanical engineer at that plant and in 1908 was transferred to the Chicago works as assistant mechanical expert. From that position he was promoted to sales engineer and then manager of steam specialties.

B. A. Parks, was graduated from the University of Michigan in 1908 and then became associated with several industrial concerns as erector, chief draftsman, and assistant engineer. In 1911 he joined his father in the firm of Byron E. Parks & Son, consulting engineers. From 1929 to 1935 he carried on that business under his own name, specializing in industrial engineering, heating, ventilating and air conditioning.

A. M. Houser was employed by the Crane Co. in 1896 as a factory laborer. Through study and hard work he secured a position in the drafting department from which he worked up to the offices of chief draftsman, mechanical expert, engineer of product, manager of engineering department. He has been especially active in standardization of piping details, valves and fittings.

M. W. Link

C. A. Olson received his engineering education at Lewis institute. He entered the employ of the Crane Co. in 1906 and soon became manager of the company's first experimental laboratory. When Crane Co. started to manufacture plumbing fixtures, he was placed in charge of the engineering for that department. Later he was put in charge of development of the company's line of boilers, radiators, air conditioning equipment, shallow and deep well pumps.

R. H. Zinkil was educated at Lewis institute and started with the Crane Co. in 1905 making blueprints in the engineering department. He advanced to tracing and up the line until 1917 when he became chief draftsman. In 1923 he was appointed manager of the testing division and held this position until 1925 when he became manager of the newly formed plumbing engineering department.

J. P. Magos received his engineering education at Armour Institute of Technology and the University of Chicago. While there he did research work in the Ryerson Physical laboratory. He has been connected with the Crane Co. since 1922 doing product design work and general testing in the product engineering department.

J. O. Lange received his bachelor of laws degree from John Marshall Law school. His post-graduate work was done at Chicago Kent College of Law and Northwestern university, specializing in corporations and patent law. He entered the employ of the Crane Co. in 1918 as mechanical draftsman and later became mechanical engineer in industrial standardization.

Announcement also was made of the creation of a new product engineering department at the Chicago works under the jurisdiction of the vice president of manufacture. Initial personnel will be C. A. Dopp, product engineer, A. M. Houser Jr., assistant product engineer and C. F. G. Neuhaus, drafting supervisor.

VICTOR A. STIBOLT recently was appointed assistant to the president, French & Hecht Inc., Davenport, Iowa, and Springfield, O. Since graduating from Cornell university in 1911, Mr. Stibolt has been identified with the farm implement and lumber industries. He has been with the Moline Plow Co.; was executive vice president of the Rock Island Plow Co., Rock Island, Ill.; and during the past three years has been connected with the Southern Pine association.

DR. IVER IGELSRUD, WILBUR H. BACHMAN, JOEL C. CARPENTER, and ALFRED BOYLES, have become connected with the Battelle Memorial institute, Columbus, O. Dr. Igelsrud is a graduate of the University of Washington and has specialized for some years in the study of industrial water supplies. He will be connected with the division of applied chemistry at the Battelle institute.

Mr. Bachman is a graduate of Ohio State university and will be connected with the division of physical metallurgy.

Joel C. Carpenter was graduated from Case School of Applied Science, Cleveland, in 1929 and has been engaged since that time in nonferrous metallurgical research principally at the plants of the Chase Brass & Copper Co. He will be connected with the process metallurgy division.

Mr. Boyles for the past ten years has been metallurgist for the Tennessee Coal Iron & Railroad Co., and is a graduate of the University of North Carolina. He will work on problems pertaining to the iron and steel industry.

ADVERTISING PAGES REMOVED

Reader's Comment

EDITOR'S NOTE—*Material Appearing Under this Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Should Be Broadcast

TO THE EDITORS:

I cannot let the opportunity escape to compliment you upon the December issue of THE FOUNDRY, with particular reference to the article concerning occupational disease, and also the one entitled, "A Letter to a Congressman."

It would seem to me that this letter should be broadcast, and each and every foundry throughout the country should send a copy of it to his local congressman. Perhaps a deluge of these would impress our Washington nuisances and awaken their dull brains to realize that there are other things to be considered besides the mere passing of fool laws. I am going to write to our congressman, representing this district, as well as my home district, calling his attention to the letter published in your magazine. In the event he is unable to obtain a copy, I am going to provide him with one.

FREDERICK H. LANDOLT
Penn Brass & Bronze Works
Brooklyn, N. Y.

Cupola Coke

TO THE EDITORS:

We recently conducted a series of tests to determine the difference, if any, between two brands of coke as cupola fuel. Two heats were taken from a 72-inch diameter cupola. Coke *A* was used in one test, while coke *B* was used in the second test. The coke bed in each instance was 45 inches deep each charge of iron was 4000 pounds and a 450-pound coke split was placed between the iron charges. Blast was supplied, 750 pounds of air per minute, by a centifugal type blower. The bed was burned through before charging was started. In the first test with coke *A* the blower was started at 11:45 a.m., and the first iron was tapped at 12 noon. A temperature reading at 12:20 showed 2780 degrees Fahr. A reading at 12:45 showed a temperature of 2820 degrees Fahr. At 1:15 the temperature was 2860 degrees, while a final reading at 2:00 p.m., showed a temperature of 2840 degrees Fahr. The cupola bottom was dropped at 3:00 p.m. Total amount melted 62 tons, or a little more than 20 tons per hour. The stream ran continuously from the spout throughout the entire heat.

The second test was conducted under exactly similar conditions with the exception that coke *B* was substituted for coke *A*. The cupola was tapped at 12 noon and the first reading at 12:20 p.m., showed a temperature of 2750 degrees Fahr. A second reading at 12:45 showed 2820 degrees. The third reading taken at 1:15 p.m., showed a temperature of 2850 degrees Fahr. Temperature at the fourth and final reading at 2:00 p.m. showed 2840 degrees Fahr. The bottom was dropped at 2:58 p.m. and the total amount melted was 63 tons.

H. M. HAZELTINE
Cupola foreman
Fremont Foundry Co.
Fremont, O.

Deoxidizer

TO THE EDITORS:

In your December issue of THE FOUNDRY on page 40 of the Question and Answer department, I notice an article on the use of boron carbide as a deoxidizer for copper.

While I take no exception to the fact that boron carbide is a good deoxidizer for copper, I believe that calcium boride has been demonstrated to be the best deoxidizer for copper. Calcium boride acts at a temperature of approximately 2200 degrees Fahr. and the usual amount required is 2 ounces to the 100 pounds.

NORMAN F. TISDALE
Molybdenum Corp. of America
Pittsburgh

Small Cupola

TO THE EDITORS:

An interesting article on small cupolas in the December issue of THE FOUNDRY prompted me to wonder how many foundrymen have had somewhat similar experiences in the past. In my own case I have had cupolas at one time or another ranging in diameter from 12 to 42 inches. I began with a stationary type cupola lined to 24 inches. About 31 years ago I found that this was too large for my requirements at the time. I built a cupola 18 inches diameter and pivoted it on a pair of trunnions. To prepare this cupola for a heat it was swung to a horizontal position and cleaned with a long bar, then daubed and returned to a vertical position. Later I built a second cupola 20 inches diameter to be operated in the same manner. Some years later I built a cupola 22 inches diameter. This cupola was parted about 12 inches above the melting zone. The upper part or stack was fixed in position, but the lower part mounted on wheels could be pulled from under the stack for daubing and repair. Later the lower part was replaced under the stack and the joint was daubed with clay. This cupola was built and placed in operation just 25 years ago.

D. W. DIETER
Dieter's Foundry
Cherryville, Pa.

Book Review

Principles of Phase Diagrams, by J. S. Marsh and John Johnston, cloth, 193 pages, published for the Engineering foundation by the McGraw-Hill Book Co. Inc., New York and supplied by THE FOUNDRY, Cleveland, for $3.00 plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., London.

This is one of the monograph series, Alloys of Iron Research, prepared under the direction of the iron alloys committee of the Engineering Foundation. Others in the series previously published include the following: *Alloys of Iron and Molybdenum* by J. L. Gregg; *Alloys of Iron and Silicon*, by Earl S. Greiner, J. S. Marsh and Bradley Stoughton, *Alloys of Iron and Tungsten*, by J. L. Gregg, and *Alloys of Iron and Copper* by J. L. Gregg and B. N. Daniloff. Others now are in preparation.

The aim of this book, as presented by the author, is to set forth, as simply as possible, yet rigorously and briefly, how the thermodynamic principles serve to interpret correctly, and to correlate the many seemingly quite different cases which actually arise even in systems of not more than three components. The reason for the presentation is to obviate the necessity of discussing questions of interpretation of phase diagrams and diagrams of state in each of the monographs. The book should prove most useful to younger metallurgists, to students, and to all those willing to go thoroughly into the subject to secure an improved understanding of other metallurgical questions.

Appointed Representative

Whitehead Bros. Co., New York, has been appointed representative of the Cleveland Quarries Co., Cleveland, for the sale of silica firestone and kindred products in eastern New York and northern New Jersey. Miller & Co., Chicago, and St. Louis, will represent the Cleveland Quarries Co. in Iowa, Nebraska, Missouri, Kansas, Oklahoma, Arkansas and southern Illinois. Frost-Naus Co., Minneapolis, will handle the sale of the products in Minnesota, North Dakota, South Dakota, and northwestern Wisconsin.

Shrinkage

by H. A. Schwartz

Third Installment

Problem 8

CALCULATE the void formed during the freezing of a sphere of metal 20 centimeters (8 inches) in diameter, as a fraction of the total initial and final volumes, poured into a mold of the same metal at 25 degrees Cent. (77 degrees Fahr.) if the initial temperature be originally 1200 degrees Cent. (2190 degrees Fahr.) and if it be 1435 degrees Cent. (2620 degrees Fahr.).

The metal is to have (so far as consistent with the simplifying assumptions) the properties of copper, namely a melting point of 1083 degrees Cent. (1981 degrees Fahr.) a diffusivity of 1.133 and a coefficient of expansion at all temperatures and in both liquid and solid states of 19×10^{-6} ([18]).

It is clear at once that our freezing conditions are the same as those applying to Fig. 6. That figure may be redrawn using the ratio $\theta : \theta_0$ and time as ordinates and drawing a separate curve for each value of the radius r. This has been done in Fig. 20, [19].

Across this diagram we have drawn lines at the values of $\theta : \theta_0$ corresponding to the melting point measured above room temperature (1083 degrees Cent.-25 degrees Cent.) if the pouring temperature, θ_0, be 1200 degrees Cent.-25 degrees Cent. and 1435 degrees Cent.-25 degrees Cent. These lines fall, by intent, at $\theta : \theta_0 = 0.90$ and $\theta : \theta_0 = 0.75$.

The intersection of these horizontal lines with the curves for the several values of the radius determine the time when the boundary between liquid and solid has advanced inward to various depths. We solve the problem from the geometric locus of the point of intersection without needing to know this time in seconds but it can be read from the time scale if that has been introduced. Consider, for example, the state of things when freezing has progressed inward to one-half the radius ($\theta : \theta_0 = 0.75$). Through the intersection of the lower horizontal ($\theta : \theta_0 = 0.75$) and the line $r = 5$ centimeters we draw a vertical line marking the time at which the temperature of this spherical shell has reached exactly the freezing point. All metal over 5 centimeters (2

(*Continued on page 52*)

Footnote references will be found at the end of this installment starting on page 56.

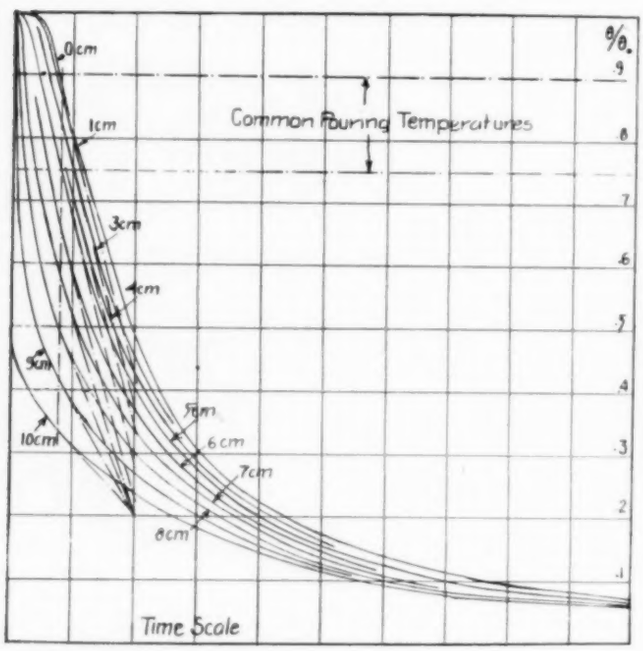


Fig. 20—Drawing a separate curve for each value of the radius r.

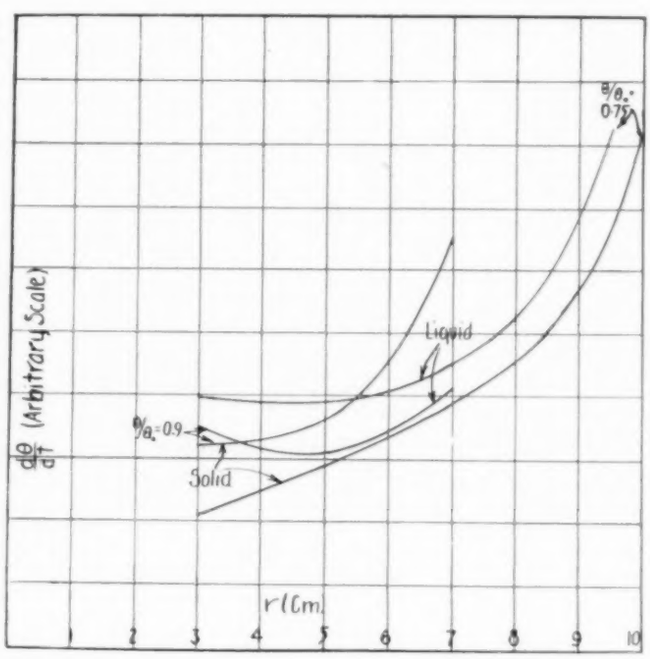
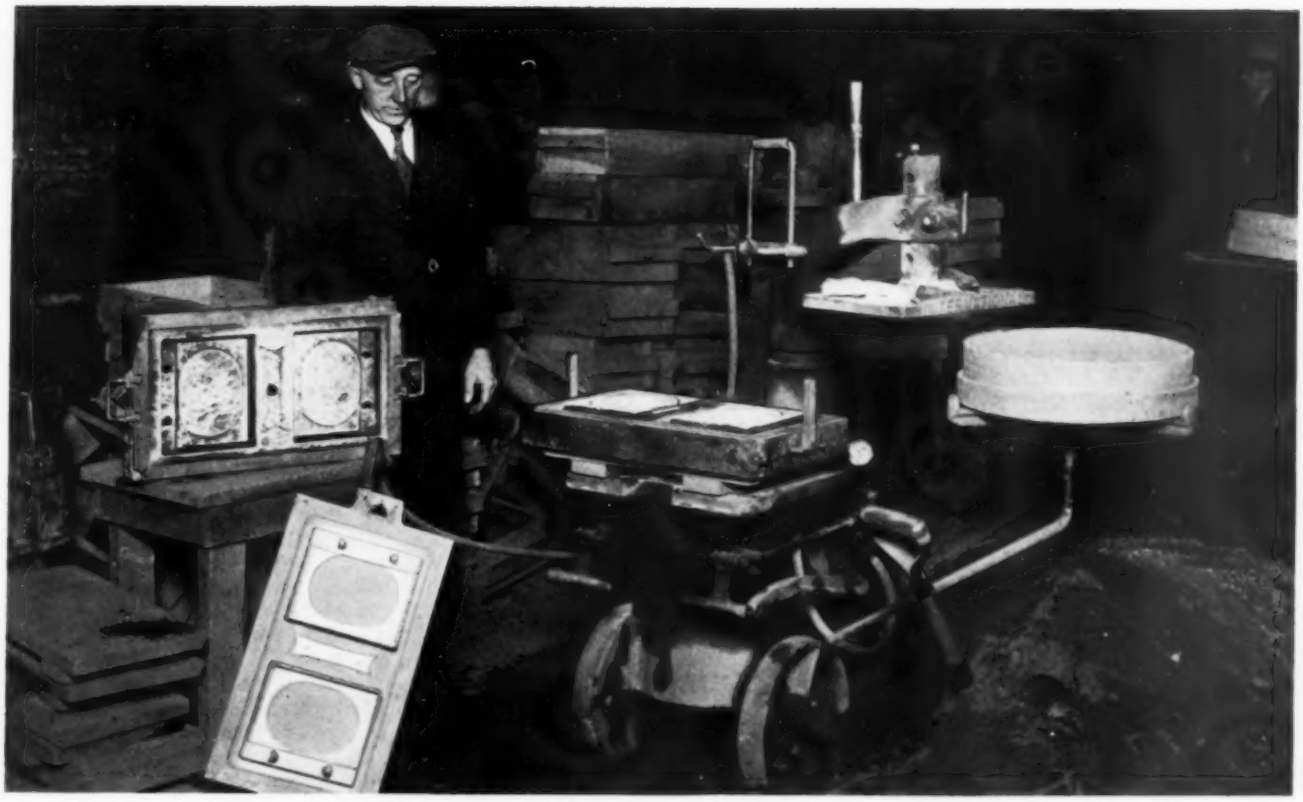


Fig. 21—Curve constructed by plotting for given values of r points marking the mean shrinkage rates of the solid crust and liquid center of the ball when the boundary between solid and liquid is at that value of r



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(*Continued from page 50*)

inches) from the center is solid, all metal closer to the center is liquid.

This temperature ordinate intersects the graph for each other radius marking the temperature (in terms of $\theta : \theta_o$) at that radius when the freezing point is reached at $r = 5$ centimeters. The slope of these lines at their points of intersection with the temperature ordinate marks the cooling rate[20] of the metal at the several levels at that moment.

We may measure this slope (merely in length units) at each intersection. These slopes will be proportional to the cooling rate and hence to the rate of shrinkage (if the coefficient of thermal expansion is assumed constant). These slopes representing relative rates of contraction can then be averaged[21] for the solid and liquid portion of the ball. For the higher pouring temperature ($\theta : \theta_o = 0.75$) the curves never intersect while for the lower pouring temperature they do so in the neighborhood of $r = 4$ centimeters. In the former case the interior always shrinks faster than the crust, in the latter it does so only after a solid layer about 6 centimeters thick has formed.

When pouring is conducted at a temperature so high (for example $\theta : \theta_o = 0.75$) that the formation of an interior void begins instantly we have under the assumed conditions of freezing when pouring is complete a crust of solid metal of negligible thickness whose temperature is $\frac{1}{2}\ \theta_o$, in the present problem $\frac{1435 - 25}{2} = 705$ degrees Cent. above that of the room surrounding a liquid center whose temperature is 1435-25 = 1410 degrees Cent. above room temperature. A sphere 20 centimeters in diameter at 705 degrees Cent. above room temperature will shrink $705 \times 20 \times 19 \times 10^{-6}$ or 0.268 centimeters and will thus have a final diameter of 19.732 centimeters while a sphere of double the temperature, shrinking twice as much, will have a final diameter of 19.464 centimeters. When the whole mass has cooled, therefore, the interior must contain a cavity whose volume is the difference in volume of these two spheres.[22] This difference in volume is just under 162 centimeters[3] which is 4.01 per cent of the final volume of the casting or 3.86 per cent of the volume of the mold. When pouring was conducted at 1200 degrees Cent., i.e. $\theta : \theta_o$ at the moment of freezing is 0.90 and the center begins to shrink away from the crust when freezing has penetrated to 4 centimeters from the center we may consult Fig. 20 for the temperature distribution in the sphere at that particular moment. It will be found that the mean temperature of the entire sphere is then 767 degrees Cent. above the final temperature of 25 degrees Cent. (i.e. 792 degrees Cent.) and the mean temperatures of the liquid center and solid crust are respectively 1088 and 706 degrees Cent. above 25 degrees Cent. (i.e. 1113 and 731 degrees Cent.).

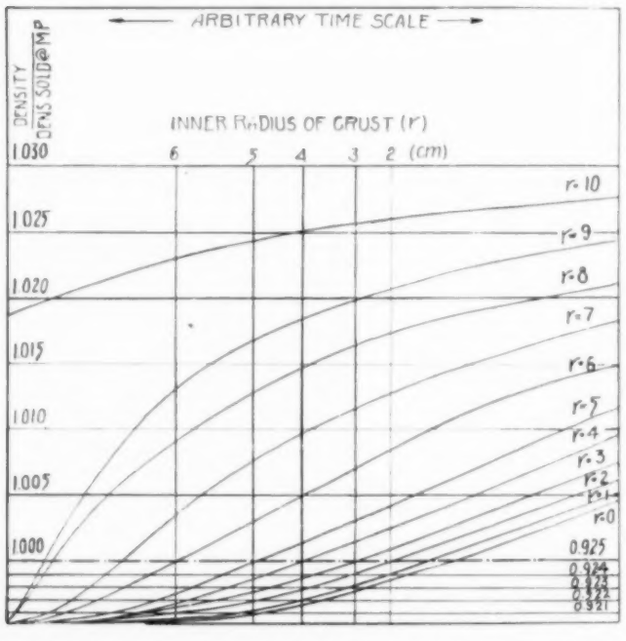

Fig. 22—Curves constructed with an arbitrary temperature scale ten times that of Fig. 20

Up to this point the sphere has shrunk as a single mass, for the crust, shrinking down on the incompressible liquid center, deformed plastically to accommodate the latter. At this time the total diameter of the sphere had decreased $20 \times (1175\text{-}767) \times 19 \times 10^{-6}$ or 0.155 centimeters and was then 19.845 centimeters. The ball of liquid metal in the center which was originally 4 centimeters in diameter had cooled 1175-1088 or 87 degrees Cent. and now has a diameter of 3.99 centimeters. At this moment the central liquid and surrounding solid can begin to shrink at different rates for the liquid is now shrinking more rapidly than the solid. In cooling through 1088 degrees Cent. the liquid globe would freeze and shrink to a diameter of 3.9851 centimeters if it remained a solid ball. The cavity in the solid crust when the latter cools the remaining 61 degrees Cent. would shrink to a diameter of 3.9929 centimeters and the difference in volume between this cavity and that of the metal which originally just filled it would be 1.56 centimeters[3] or about 0.03 per cent of that of the entire ball.[22] The outer diameter of the ball in cooling will decrease about 0.0024 centimeters more, to say 19.843 centimeters.

We thus see that even for an ideal metal having a greater uniformity of properties as between solid and liquid than any real metal can possibly have gradients during freezing will cause the formation of shrinkage voids. These voids grow less with decreasing superheat and the over-all size of the casting apparently increases as the pouring temperature decreases[24]. One might plot a graph correlating pouring temperature with shrinkage void by calculations similar to those previously given for other pouring temperatures. The process would be instructive but the results would be of little practical value for the peculiar properties of the metal assumed to make the initial treatment as simple as possible are never found in practice.

Since the shrinkage voids are here found to be due to temperature gradients alone, it is clear that in the absence of gradients our ideal metal would yield completely sound castings. Reference to Figs. 12, 13 and 14 shows that for castings poured in sand temperature gradients will have disappeared by the time metal poured under any practical temperature conditions has solidified at the surface. It follows that in sand molds our postulated ideal metal would not give shrinkage voids and hence that such voids in castings so molded must be due to other properties of the metal than those so far assumed to exist. All metals change in volume as they melt. Usually they expand though some, notably the alloys of bismuth and antimony with other low melting metals contract (type metal for instance). Gray cast iron contracts on freezing (to white iron) but expands at and just below the melting point because of the liberation of carbon as graphite. The amount of expansion is then dependent upon composition and cooling rate.

So long as we are considering metals with a sharp melting point we are limited to pure metals and certain particular alloys of so called *eutectic* composition. Alloys of eutectic[25] composition are not often made into castings by the foundryman. All our past discussion has been of the pure metals; copper, iron and aluminum. The best available data seem to show that copper experiences only a negligible change of volume during freezing, pure iron contracts about 3 per cent by volume and alumi-

(*Continued on page 55*)

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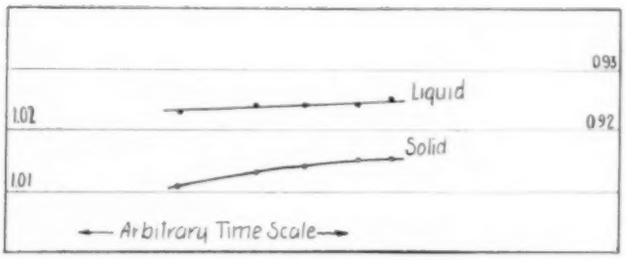

Fig. 23—Densities plotted against the time scale of Fig. 22. Rate of contraction of each mass, the liquid interior and solid crust, is given by the slope of the lines

(*Continued from page 52*)

num somewhat less than 8 per cent. If then balls 20 centimeters in diameter of these metals freeze in sand molds without internal temperature gradients it is quite obvious that the castings must contain internal voids after freezing whose volumes are respectively negligible for copper, 3 per cent of the volume of the casting for iron and less than 8 per cent for pure aluminum.

Under these freezing conditions the original superheat (above the melting point) of the metal manifests itself as a settle or flattening at the top of the sphere whose volume bears that relation to the volume of the mold that the shrinkage in volume in cooling to the melting point bears to the volume of the mold. If the coefficient of expansion is a constant this is the ratio of the difference between pouring temperature and freezing point to the difference of pouring and final temperature. Thus if the coefficient of cubic expansion of liquid copper near its melting point is 75×10^{-6} [31] then a sphere poured at 1183 degrees Cent., i.e. 100 degrees above the melting point, will on freezing, be found flattened at the top by an amount such that the volume of the casting is

$$1 - 100 \times 75 \times 10^{-6} \text{ or } 0.9925$$

times the volume of a complete sphere of the same radius[32].

It is possible to consider the simultaneous effect of a change of volume on freezing and a temperature gradient.

Problem 9

What is the volume of the void in a ball of aluminum cast in an aluminum mold 20 centimeters in diameter and of great thickness on cooling to 25 degrees Cent. (77 degrees Fahr. room temperature) if the pouring temperature be 872 degrees Cent. (1600 degrees Fahr.) or 735 degrees Cent. (1355 degrees Fahr.).

These temperatures represent values of $\frac{\theta}{\theta_0}$ of 0.90 and 0.75 respectively, the melting point of aluminum being 660 degrees Cent. Aluminum is taken as having a uniform coefficient of thermal expansion of 22×10^{-6} and as shrinkage 7½ per cent (by volume) on freezing. For the higher pouring temperature it was shown in Problem 8 that the liquid contents began to shrink away from the extremely thin solid crust as soon as the latter formed. This will be all the more true if there is a contraction on freezing. The solid skin at the moment of formation is 436 degrees Cent. above room temperature and hence will decrease in radius

$$436 \times 10 \times 22 \times 10^{-6} = 0.0959 \text{ centimeters to } 9.9041 \text{ centimeters.}$$

The liquid center would first cool 212 degrees Cent. experiencing a contraction in radius of

$$212 \times 10 \times 22 \times 10^{-6} = 0.00424 \text{ centimeters to } 9.99576 \text{ centimeters.}$$

It would then contract 2½ per cent (1/3 of 7½ per cent) on freezing to 9.7459 centimeters and then cool 635 degrees Cent. further, shrinking in the process $9.7459 \times 635 \times 22 \times 10^{-6} = 0.1362$ centimeters to 9.6097 centimeters. The difference in volume of the two spheres is then

$$4/3\ \pi\ (9.7459^3 - 9.6097^3) = 160 \text{ centimeters}^3.$$

So far we have merely had to add the shrinkage from two different causes. For the lower pouring temperature the problem becomes more complex for we must determine whether the change of volume on freezing affects the thickness of solid crust at the moment when the center begins to shrink away".

From Fig. 20 we construct the curves of Fig. 22 using an arbitrary temperature scale, here 10 times that of Fig. 20 for convenience. Except during freezing, densities are proportional to temperature. At the change of state there is a discontinuous change of density represented in the figure by a discontinuity in the vertical density scale at the horizontal dot and dash line corresponding to the melting point. We may now draw vertical ordinates through the points of intersection of the curves for the temperatures at various radii with the horizontal line representing the freezing point. The intersections of these lines with the several curves give the density at the several radii when freezing has progressed to the corresponding distance. From these readings we may compute the mean densities of the solid and liquid layers at the times when freezing has progressed to given points.

In Fig. 23 these densities have been plotted against the time scale of Fig. 22. The rate of contraction of each mass, the liquid interior and solid crust, is then given by the slope of these lines. The line representing the liquid density is nearly straight (of constant slope). Unfortunately the slope of the solid density line is for a large portion of its length so nearly constant and equal to that of the liquid that it is not very plain just where the two lines have the same slope although it is obvious that the line for the solid crust grows flatter as time goes on (i.e. as freezing progresses inward) while that for the liquid does not change greatly in slope and that there is some point where the two lines have the same slope. At later times than represented by this point the liquid shrinks more rapidly than the solid and vice versa.

The point where this occurs is at least not far away from the time when freezing has progressed to within 3 or 4 centimeters from the center as shown in Fig. 22 [33].

Assuming then as in Problem 8 that the shrinkage void begins to form when freezing has progressed to 4 centimeters from the center and neglecting the trivial correction arising from the fact that this sphere after partial cooling is somewhat less than 8 centimeters in diameter, we have as the total shrinkage the difference in volume of two spheres both of 4 centimeters radius and one of density 0.924, the other of density 1.014 when both shrink until their density becomes (at room temperature) 1.042 due to a shrinkage from density 1 at 660 through 635 degrees Cent. to 25 degrees Cent. the (cubic) contraction hence 66×10^{-6} per 1 degree Cent.

The sphere of lower density will then have a volume 0.887 times that when shrinkage begins and the denser sphere 0.973 times the original volume. The shrinkage is therefore $(.973 - .887)\frac{4}{3}\ \pi\ 4^3 = 23 +$ centimeters[3]

All substances have what is called a latent heat of fusion, that is to say during melting they absorb and during freezing they liberate heat without change of temperature. For the three metals so far considered the latent heats of fusion are aluminum = 80 calories per gram, copper = 50 calories per gram, iron = 69 calories per gram.[34] When molten metal cools in sand molds the curves of Fig. 10 would be altered by the introduction of a horizontal line at the melting point whose length will depend upon the latent heat of fusion of the metal and the prevailing cooling rate.

(*To Be Continued*)

[33] Assumed fairly high because of high maximum temperature. The diffusivity is, of course, also not really that at room temperature which

is here assumed. These discrepancies are not very important since we are for the present neglecting two larger sources of error, the change of density at the melting point and the latent heat of fusion.

[19]Although the time scale for copper is used in the figure it will presently appear that we use only relative values of $\theta : \theta_0$ and of time so Fig. 20 would apply equally well to metal of any other diffusivity with merely an appropriate renumbering of the scale of the abscissas. In fact we use only the relative slope of the various lines at certain selected time ordinates without needing to know the absolute values of these times at all so that no numbering of the horizontal scale in terms of seconds is actually involved in the solution of the problem.

[20]If the time scale is not known this slope represents

$$\frac{d\ (\theta : \theta_0)}{d\ h^2\ t} = \frac{1}{h^2\ \theta_0} \cdot \frac{d\ \theta}{d\ t}$$

We are subsequently concerned only with the *relative slope* of these lines so need not trouble to draw the constant $\frac{1}{h^2\ \theta_0}$ into the calculation.

[21]By the method outlined in Footnote [14] Fig. 21 may be constructed in which we plot for given values of r points marking the mean shrinkage rates of the solid crust and liquid center of the ball when the boundary between solid and liquid is at that value of r. Curves can be drawn through the corresponding points at different values of r and these curves will intersect if the crust as a whole first shrinks more rapidly and then more slowly than the liquid as a whole (or vice versa).

[22]We do not here consider the possibility of a collapse of the outer shell under atmospheric pressure.

[23]The number is so small that it is practically the same for the volume of the solidified ball as for the original mold volume. We have not considered that the freezing metal accumulating on the inner surface of the mold affected the latter's shrinkage in any way.

[24]The reader who finds that the calculated outer diameter less the shrinkage void represents more metal than that contained in the frozen ball poured at $\theta : \theta_0 = 0.75$ is reminded that a mold of given size holds more cold metal than hot. Also the assumption upon which the shrinkage of a solid mass of nonuniform temperature were calculated may require some modification.

[25]The reader who requires a definition of the term cutectic composition may consider the following. The melting point of any substance is, in general, decreased by the addition of another substance. Often the temperature at which solid metal will freeze out of an alloy of two metals is lower than the freezing point of either constituent. It is always lower than the melting (i.e. freezing point) of the metal of higher freezing point. The alloy, however, does not freeze completely at this the socalled *liquidus temperature*. In certain alloys called *eutectiferous* there is found one composition whose *liquidus* is not only the lowest of all but coincides with the *solidus*. In these alloys the solidus is the same regardless of composition over a long range of composition. That composition for which the solidus and liquidus are the same and the latter at a minimum is called the eutectic composition. The commonest is the alloy of iron and carbon containing in the absence of silicon 4.3 per cent of carbon. The lead-tin solder containing 62 per cent tin is another.

[26]This value is purely an estimate but may not be far wrong.

[27]The amount of this flattening and the diameter of the upper flat surface become a problem in the geometry of a sphere for which we need not take space for our present purpose.

[28]We can not proceed exactly as from Fig. 20 for an infinitely thin shell, just at the melting point is shrinking at infinite rate through a limited range; we would thus have to introduce into an average shrinking rate a term involving the product of zero and infinity which is mathematically indeterminate.

[29]Other methods of reasoning show that this should be so but the methods, though more exact than the graphic treatment here adopted, were thought less easy to follow by those who do not care for calculus methods.

[30]Data of Umino, *Science Reports* of Tohoku Imperial university, 1927. The fractions of calories have been rounded off to the nearest whole number.

Michigan State Announces Short Course

Michigan State college, and the Detroit chapter of the American Foundrymen's association are co-operating for the fourth consecutive year in staging a foundry short course at East Lansing, Mich., on Friday, Feb. 7. This year the program for this most important conference will be completed in one day, with technical sessions in the morning and afternoon, and an evening dinner meeting followed by further technical discussions.

The general subject for discussion at the February meeting will be "The Properties of Gray Iron Castings As Affected by Superheating Temperatures." The morning session under the chairmanship of W. H. Spencer, metallurgist, Sealed Power Corp., Muskegon, Mich., will feature the presentation of a report of an investigation on that subject carried out by the college experiment station by M. F. Surls and Frederick G. Sefing, Michigan State college. This will be followed by a discussion, "Gray Iron Structures and Their Effects on Physical Properties," by V. A. Crosby, Climax Molybdenum Corp., Detroit.

The afternoon session under the chairmanship of Fred J. Walls, International Nickel Co. Inc., New York, will be devoted to the following discussions: "The Effect of Superheating Temperature Alone on Gray Iron Mixtures," by Dr. Armand Di Guilio, Ford Motor Co., Detroit; "The Effect of Time at Superheating Temperatures on Gray Iron Mixtures," by H. S. Austin, Buick Motor Co., Flint, Mich.; and "Relation Between Superheating, Size of Section and Structure of Gray Iron," by Harry Raynor, Dodge Bros. Corp., Detroit.

Vaughan Reid, president, City Pattern Works, Detroit, and chairman of the Detroit chapter of the American Foundrymen's association, will preside at the evening dinner meeting. Following the dinner, R. G. McElwee, Detroit, wil discuss "The Influence of High Temperatures on the Chemical Analysis and the Effect of Small Changes in the Chemical Analysis on the Physical Properties."

Local arrangements are in charge of Frederick G. Sefing of Michigan State college. The co-operating organization extends a cordial invitation to all foundrymen and others interested in the subject to attend the meeting. No registration will be charged.

A. S. M. Chapter Hears Talk on Gray Cast Iron

Hyman Bornstein, Deere & Co., Moline, Ill., presented a talk on "Cast Iron and Its Heat Treatment" before the Chicago chapter of the A.S.M. on Dec. 12. Mr. Bornstein covered the various phases of the subject, such as manufacture, effect of the elements and alloys, heat treatment and engineering properties.

Mr. Bornstein defined cast iron as a combination of carbon and silicon, usually having over 1.7 per cent carbon. He described the various furnaces used in manufacture and compared the processes with respect to cost, quality of iron and adaptability. Carbon was mentioned as one of the most important elements, with silicon, sulphur, manganese and phosphorus in order of importance in affecting the iron. The speaker described the results obtained by adding alloys such as nickel, chromium, molybdenum, vanadium, and copper with reference to structure, machinability and corrosion resistance.

High strength irons were discussed including centrifugal cast iron brake drums. The speaker pointed out that heat treatment of iron has developed more in the past few years, and is as susceptible to heat treatment as steel. However, it has been confined to simpler shapes due to its brittleness in quenching.

Quad City Chapter Hears Talk on Russia

Quad-City chapter of the American Foundrymen's association held its regular meeting at the Blackhawk hotel, Davenport, Iowa, on Dec. 16 with 95 in attendance. A number of visitors from surrounding cities were present. F. A. Jensen, Wm. H. Nicholls Co., spoke on "Foundry Conditions in Russia." The speaker told of his personal connections with the foundry industry in this country and explained how he came to work on the project in Russia. He explained that the production secured from well mechanized foundries in Russia is considerably less than that which can be secured from similar plants in this country due to the intelligence of the American workman. He believes that it will take many years for Russian industry to reach the state of development found in other European countries and in America. An interesting discussion period on the Russian situation followed the formal presentation.

The next meeting of the chapter will be held at the Fort Armstrong hotel, on Jan. 20. Glenn Gardner will talk on "Industrial Relations."

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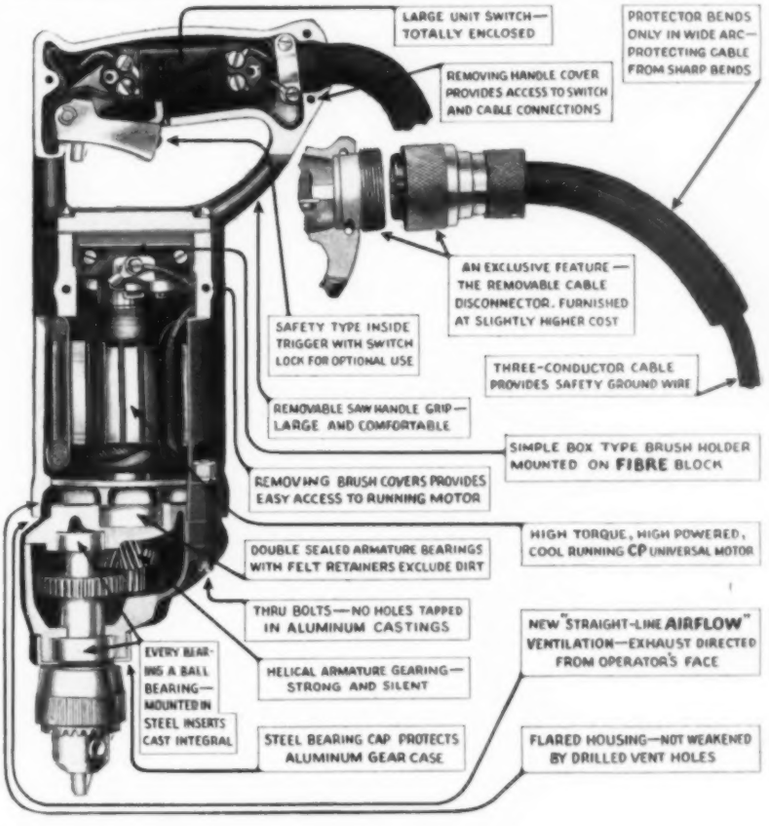
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Is this a time for conundrums?

The Adventures of BILL

By PAT DWYER

A COUPLE of weeks ago," Bill said, "I read a piece you had in THE FOUNDRY about barrels and smells and old memories and one thing and another. Interesting kind of stuff, but it seems to me you omitted many of the most important features. F'rinstance supposing your best friend, or for that matter any other person was to stop you on the street tomorrow and ask you as man to man, who made the first wooden barrel? What would you say?"

"Well," I said, "the answer would depend to a considerable extent on the size and general heft of the asker. If he wasn't too big I might counter by asking: What first wooden barrel? Who cares, who wants to know and what of it? Is this a time, I should inquire coldly, to be babbling of the first barrel when the last barrel is on tap in the nearest life saving station?

"After the second round, should he persist in his inquiry, I probably would answer him courteously to the effect that the event occurred before my time. I really had no first hand knowledge of the subject, but by and large and in a general way I was inclined to the opinion that the first wooden barrel was made in China."

"Just so," says Bill, "Just so. The old weasel under the gate. Waxing mildly enthusiastic after the third one, you would direct his attention to the widely circulated remarks of one B. Harte touching on ways that are dark and tricks that are vain. Cunning and skillful lads, these here now Chinese. Look at their writing. No one except themselves can read it or make head or tail of it. Deep stuff. They invented processes for making paper, textiles, porcelain, chow mein, chop suey and gun powder before the inhabitants of occidental Europe had emerged from their swaddling clothes. If indeed — and kindly note this — a highly controversial point—if indeed these hardy and hairy barbarians ever indulged in such effeminate practice as wearing swaddling clothes.

"Some place or other you seem to have a recollection of reading that the Chinese were skilled in metallurgy, in the manipulation of iron and bronze when contemporary Europeans were catching fish with their nails and with bone hooks and were playing tick-tack-toe on their enemies and on each other with sling shots and stone clubs. Bronze bells and other metal objects have been found in China—never mind for the moment who found 'em—bearing marks that indicate they were cast 2000 years—well, maybe a few more or less—anyway what's the difference? —cast 2000 years before the Three Wise Men—certainly you remember the Three Wise Men? Names escape me for the moment. L'es call 'em *A*, *B* and *C*. What's that? Balthazar, Casper and Melchior? Sure, them's the babies.

The students tackle a tough one

"Well, as I was saying, these castings were made 2000 years before the Three Wise Men left their homes to follow a blazing star—No, she was not in the movies—followed a blazing star—you are thinking of three other fellows—across the trackless desert to its ultimate destination over a lowly stable crib in the little village of Bethlehem in the mountains of Judea.

"And please old pal, do not confuse this place with Bethlehem, Pa. Another town altogether.

"The mariner's compass — you know the dingus for steering a ship —was invented in China and was in use for centuries before Marco Polo stumbled across it on one of his hobo trips and brought the knowledge, and probably a sample back with him to Europe. Like all explorers, Mark was quite a lad for picking up little odds and ends. Anything not too hot, too heavy, or not too solidly nailed down.

"Having recited all the foregoing facts, and perhaps others, depending on the condition of your memory and strength of your imagination, you return to your original statement and calmly announce that in all probability, yes sir, you are willing to be quoted on this point, in all probability, the wooden barrel was invented in China.

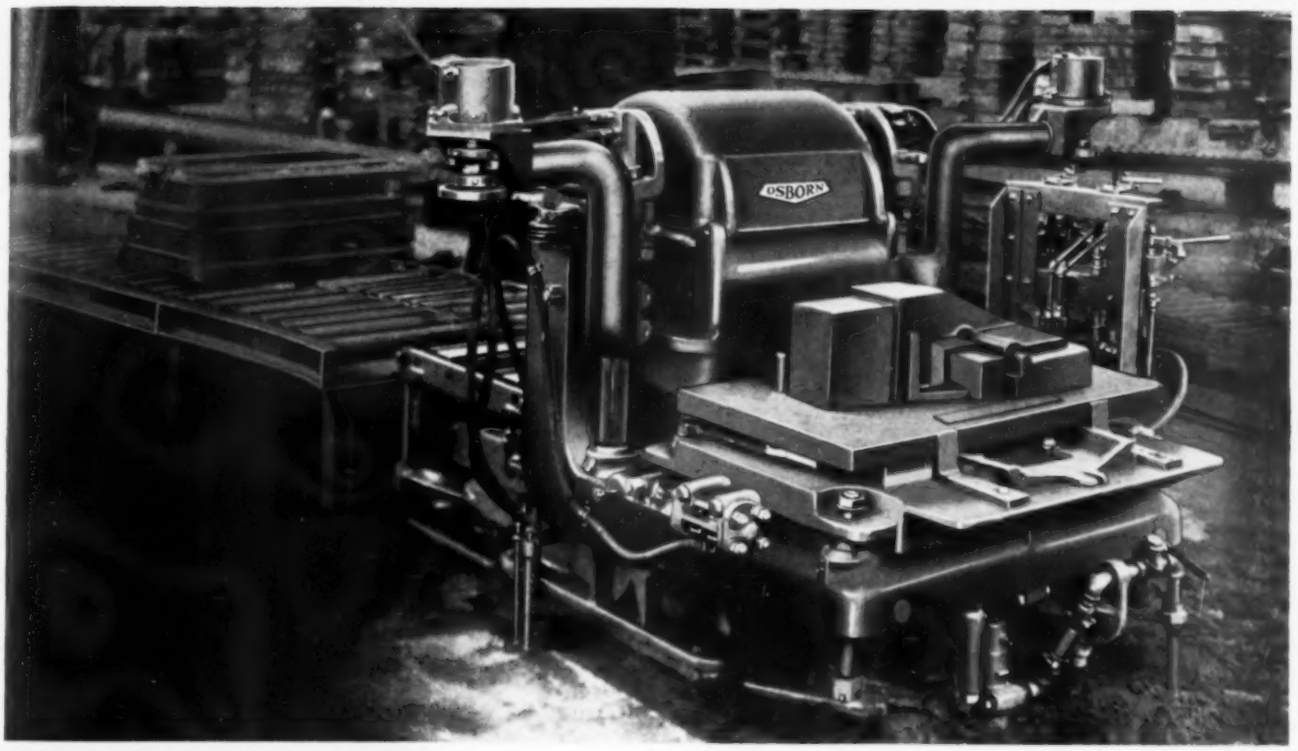
"Friend, you would be all wrong. All wet. In the red and up Salt Creek without a paddle. No less an authority than the *Encyclopedia Americana* boldly states that the Chinese, with all their ingenuity, never made a wooden barrel.

"Believe it or not. Take it or leave it. There it is in black and white. And that's that."

"While you were on the job," I pointed out, "you might have dipped a little deeper. To the same excellent and infallible authority we are indebted for the knowledge that wooden barrels were in common use in

(*Concluded on page* 60)

ANNOUNCING



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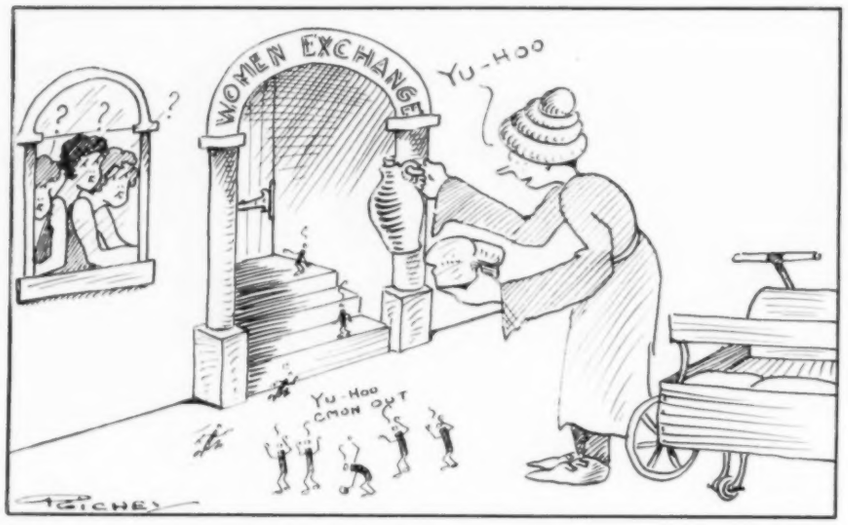
(*Concluded from page* 58)

the days of the Early Roman empire, but on anything pertaining to barrels antedating that period ye deponent is discreetly silent. This is all the more remarkable when one reflects on certain well authenticated historical events in the—if one may coin a phrase—good old days B. C., before Caesar.

"For example there is the case history of that genuine old sea dog Noah. Pickled in brine and smelling strongly of pitch and oakum he was first of the millions of men that go down to the sea in ships and venture on the waters of the great deep. His



Omar does a little preparatory spade work

reputation rests upon his skill as a shipbuilder rather than upon his knowledge of navigation; although his feat in finally making port without the assistance of any navigating instruments, if we except one tired dove, would seem to indicate that he knew his way around. Just around. He was not going any place.

"As a shipbuilder, big game hunter and manager of a zoo he was in a class by himself. Without stretching the imagination beyond reasonable bounds, one may assume that a man sufficiently skilled in wood work to build a ship, also would have sufficient skill and ingenuity to build a barrel, or, for that matter, any number of barrels in which to store water and provisions for himself, his family and his feathered, hairy and scaly guests on the 40-day personally conducted tour to Ararat and way ports.

"To the suggestion that he could have thrown a bucket attached to a rope over the side and drawn up all the water he needed at any time, one only has to say: 'Have you ever tried to water a circus elephant?' Well, then.

"Having existed on water, inside and outside for a period of 40 days, it is not surprising to find that in his later and presumably wiser years Noah displayed a marked aversion for this liquid, particularly as a beverage. Enough is enough and then some.

"He planted a vineyard before the silt had dried along the levee—sounds like the title or refrain of a song—and in due time lapped up the grape juice free and frequent and, sad to relate, in a manner characterized more by enthusiasm than by discretion. In all charity and emulating the example of his sons upon at least one of these occasions let us throw a blanket over the merry old roisterer while we tread lightly and peep discreetly among the lares and penates. If we do not see a goodly size wine barrel packed away under a tarpaulin in one corner, then all I have to say is that we miss our guess by a long sea mile.

"True, the accepted story of Noah contains no specific reference to a barrel or barrels, but the impartial student also will note that no other type of container is mentioned. Thus far in our investigation, the verdict is 50-50 for and against the barrel theory. However, let us read between the lines and see what we shall see:

"Item 1—Noah had a practically unlimited supply of sawn timber, ready to hand in the shape of one slightly used ark.

"Item 2—He had a positive guarantee that the aforesaid ark never would be needed again.

"Item 3—He was an exceedingly handy lad with the axe and draw knife.

"Taking these various items singly or collectively into consideration, it seems fairly obvious, even to an amateur commentator, that some of the timber was converted into a wine press and the remainder into barrels of various sizes, designed to carry a generous supply of the invigorator from one harvest time to another.

"Poets, near poets and other more or less male and female literati are dippers and scoopers, occasionally to refer to the pipes of Pan. This highly boisterous gent, with the cloven hoofs and the ears of a goat, usually is depicted in joyous mood, gaily gamboling over the green, the while he blows into a graduated reed instrument, resembling—at a distance and in the usual illustration—a handfull, or as it sometimes is known colloquially, a mess of spare ribs.

"As a plain matter of fact the original pipes probably were pipes of vin rouge, good stout, round bellied barrels of fermented grape juice. After an intensive and protracted session under the spigot, one readily can imagine Pan rising up on his hind legs and giving a spirited rendition of the Dance of the Hours, the Cancan, the Hootchie-cootchie or the Carmagnol. A strictly modern version probably would represent the old boy manipulating a pair of fans.

"Just imagine what Roy Atwell could do with a phrase like that, the fans of Pan!

"Unfortunately I have not the original Greek version by me at the moment, but without doubt, the word was barrel—the Greeks had a word for anything and everything—and this word barrel was translated by the eighteenth century English poets as *pipe*, the accepted term in those hard drinking days for a barrel, cask, hogshead or puncheon of wine.

"Memoirs of a Persian gent, one Omar Khayyam, refer to a jug of wine and a loaf of bread as two thirds of a necessary combination for a perfect day in the woods, the wilderness, or possibly any other place. While the reference to wood does not necessarily constitute direct proof that Omar had a barrel on tap, still it is not unreasonable to assume that he had access to (a) a barrel in his own cellar or (b) that his credit was good in the pub at the corner of Iraq street and Grand Bagdad boulevard. One jug would not go very far on a hot day or night.

"Omar claims that a jug of wine, a loaf of bread and thou would be enough and sufficient. Too optimistic. Like the leaves of the forest, these all fade away. Oversight error in this instance charged to exalted condition.

"He supplies no statistics covering the volume, cubical content, or holding capacity of the jug, the loaf of bread or the thou, but it is reasonable to infer that on sober second thought, this cagy lad would have a supply base from which he might refill the jug, replenish the bread basket and pick up a new thou now and again. A good old Spanish custom."

"I know another good old Spanish custom," said Bill, "and that is to shut off the wind when the cupola is empty. Good night!"

Malleable Foundry Duplexes Iron

(*Continued from page* 24)

tion it is interesting to note that an improved type skimmer has been developed for removing the slag in this furnace. As shown in Fig. 4 a cast iron roller mounted on a swinging arm supports the weight of the skimmer. The solid skimmer handle is welded to a double pipe, one inside the other. The outer pipe at the far end is welded to the alloy steel blade which also is hollow. Two short lengths of hose are attached to the operator's end of the pipe handle. One admits water to the outside pipe and blade. The water returns through the inside pipe and is discharged through the second hose. Where formerly the skimmer ends had to be constantly renewed at considerable monthly cost, the present skimmer has been in constant use for over a year, and apparently is good for indefinite service. The slag door is located opposite the point where metal flows in from the cupola, and near the end of the furnace furthest away from the powdered coal burners.

In the daily operation of the air furnace the consumption of coal is 250 pounds per ton of iron. A pile of slack coal shown in Fig. 3 is fed into a hopper from which it passes in regulated volume to the pulverizer shown at the left in Fig. 1. An air blast delivers the coal to the burners and supplies the necessary oxygen for combustion. Through a supplementary air line the volume of air is regulated to meet fluctuating conditions. Through adjustable vanes in the pulverizer the fineness of the coal also may be changed to a considerable extent. Thus at or near the close of the heat, with no fresh metal coming into the furnace from the cupola, and with the carbon dropping, the vanes are set to deliver coarser coal which is not completely consumed in the flame but falls on the bath where it helps to restore the carbon. Petroleum coke also is added directly the bath for the same purpose.

Metal is taken from the furnace in eight 500-pound ladles, two of which are shown in Fig. 2. A loop from the main line of the monorail brings the ladles in constant succession under the spout, and except under exceptional circumstances the stream is allowed to flow constantly from the tap hole. With the exception that the quantity of metal taken in each ladle is greater, the entire operation is similar to the usual practice where the operators stand in line and *catch under* with hand ladles. The breast of the furnace contains three tap holes, two above and one below. Either or both the upper tap holes are used for the greater part of the heat. The lower tap hole is used toward the close of the heat to drain the last iron out of the furnace. So long as the cupola is melting and delivering iron, the bath in the air furnace is maintained at a fairly constant level. Withdrawal of iron in the ladles is maintained at the same rate as the entrance of iron from the cupola. In the event of unforeseen interruption in the pouring of the iron, two flexible links are available in the cycle. Melting speed of the cupola may be increased or retarded — within reasonable limits — by blower adjustment. The stream from the air furnace may be stopped temporarily.

Fig. 6—Charges for the cupola are made up in drop bottom buckets resting on a depressed scale. Each bucket holds all the component parts of a complete charge

Shank and bail on this type of ladle as shown in Fig. 2 differ from the usual type in that they are on one side of the ladle. The bail is only a half loop instead of the regulation full loop embracing both sides of the ladle. With this arrangement the second man can shove his ladle close to the spout before the first man removes his ladle. A light horizontal rod extending from the double end of the shank to the bail operates a movable arm which locks the bail and maintains the ladle in an upright position while in transit to and from the furnace. When the lock is released the operator holds the ladle steady by the handles and is free to manipulate it in filling the hand ladles with metal.

The ladles are suspended from light chain hoists. The monorail is perfectly level to facilitate movement of the ladles to any section of the foundry, but the floor of the foundry following the natural contour of the surrounding territory is about 2 feet higher at one end of the long bay than it is at the other end and also higher than it is in the vicinity of the furnace. Hence the necessity of hoisting or lowering the ladles to meet this condition. Switches at various points on the monorail permit filled and empty ladles to pass each other readily.

For many years after its establishment over 50 years ago the Eberhard Mfg. Co. engaged exclusively in the manufacture of saddlery and carriage hardware castings. In recent years with a relegation of horses and horse drawn vehicles to the background, the character of the product has changed to a considerable extent and now embraces a wide miscellany of castings employed in many fields and ranging in weight from fractions of an ounce to 300 pounds. In this connection and in line with the trend of the times it is interesting to note that the company now is engaged in manufacturing the chassis for a new type of milk wagon mounted on pneumatic tires.

In its original specialty line the company carried on an extensive export business and shipped castings to many foreign countries. Although shrunken to some extent during the past 5 years of world wide depression this potential market still exists. Evidence of a quickening is seen in a recent sizeable order for carriage steps shipped to a customer in Argentine, South America, where the horse and carriage flourish on a scale familiar only to the older inhabitants of the United States.

The casting is made in two styles, one with a single and one with a double step. Mold and pattern equipment for a double step casting are shown in Fig. 7. A special snap flask with the joint cut to conform to the irregular parting line is employed for

making the molds. The circular step part of the one-piece metal pattern is thick enough to serve as a core print for a flat disk core. The back of the core fits snugly against the green sand in the mold, while the front is scored with criss-cross indentations which are reproduced in obverse on the face of the step to prevent the passenger's foot from slipping.

The follow board shown at the left in Fig. 7 is a frame filled with clay manipulated to the desired shape while in a plastic state and then allowed to harden over night. This type of follow board, described in considerable detail in the June 15, 1933 issue of THE FOUNDRY has been in use in this plant for many years. It is simple, comparatively inexpensive and gives eminent satisfaction. The drag part of the mold is formed on the follow board. Then both parts are rolled over and the follow board is removed. The cope is rammed on the drag.

Cope and drag metal pattern plates for an automobile wheel center are shown in Fig. 8 which also shows a squeezer machine for the copes at the left and jolt roll-over machines for the drags at the right. The two machines are connected by a short length of roller conveyor on which the molds as assembled before they are placed on the floor. The molds are made in a metal flask with sand strips at the joint. After the mold is assembled, the sand strips are withdrawn and the slightly tapered flask is removed from the body of sand. Although the flask is 20 x 20½-inches, no bars are needed in the cope. Metal is poured through a sprue in the center which is connected at the bottom with four small gates formed in a dry sand core. One of these cores is shown in the center of the drag pattern at the right, while a second core showing the obverse side, rests on the upper edge of the pattern. Another small core is bedded in the center of the cope face to provide a firm non-washable opening at the lower end of the sprue.

Method of gating a brake drum casting is shown in Fig. 9. Metal from two ladles is poured into sprues at diagonally opposite corners of the cope. The runner conducts the metal to a shrink bob and thence through a small gate into the mold. A feeding head is placed on each of the small bosses shown on top of the cope pattern at the right.

Newspaper Features Castings and Facings

A recent article in the *Detroit Free Press* illustrates a casting weighing 96,000 pounds made by the Detroit Gray Iron Foundry Co., and also molders producing a large pit mold at that foundry. The fact that two Detroit companies co-operated in the production is pointed out as follows: "Detroit Gray Iron Foundry specializes in making large castings of gray iron for machinery builders and others, a class of work which requires that the castings have a smooth, clean surface. The sand molds for these castings must be 'faced' with high carbon graphite known to the trade as East India plumbago, and numerous other kinds of foundry facing, all of which are manufactured in Detroit at the facing mill of Frederic B. Stevens Inc., located on Twenty-second street."

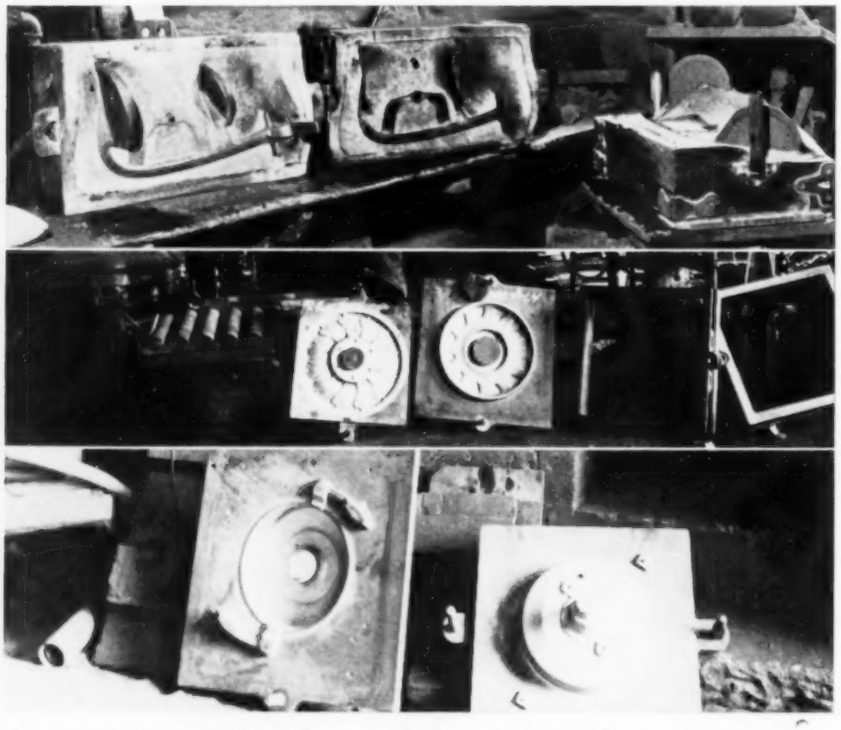


Fig. 7 (Top)—Follow board, pattern and mold for double carriage step. Fig. 8 (Center)—The center gate is formed on the pattern with two dry sand cores. Fig. 9 (Bottom)—Brake drum casting is gated at opposite sides and provided with two risers at top

Probe Sand Uses and Reclamation at Chicago

Sand use in the foundry occupied the attention of the Chicago chapter, American Foundrymen's association, at its monthly meeting, held Dec. 16 at the Medinah club, with an attendance of about 100. Speakers were H. W. Dietert, Harry W. Dietert Co., Detroit, and L. B. Knight Jr., National Engineering Co., Chicago.

Mr. Dietert, in discussing casting defects, pointed out that the cause of such imperfections is not always a singular condition but rather a series of conditions. Therefore it is possible, to have one or more direct causes and one or more indirect causes that collectively cause a casting defect. Casting troubles may be traceable to the character of the sand, to its preparation, to its molding or to a combination of these factors.

The speaker presented a number of slides illustrating different casting defects, such as blows, scabs, rough surface, pin holes, rat tails, gas seams, etc., describing the causes of these troubles and the methods for correcting them.

Mr. Knight described sand reclamation and reconditioning methods from the standpoint of improvement in castings and saving in costs. The four steps in this process consist of: The removal of foreign material; control of the amount of fines; regulation of amount of bond and moisture; and aeration. Typical installations of equipment for handling as little as 2 to 3 tons of sand per hour and as much as 70 tons per hour were illustrated. Mr. Knight also cited savings effected by several foundries through sand reclamation. One malleable plant reported that its reduction in scrap losses alone paid for the installation within eight months, leaving a substantial profit from the saving in new silica sand consumption.

Harry D. Harvey, trading as a Monarch Engineering & Mfg. Co., has been reorganized and the business transferred to a new corporation organized as the Monarch Engineering & Mfg. Co., 4221 Curtis avenue, Baltimore.

Superheats and Refines Cast Iron

(*Concluded from page 27*)

has an effect similar to stirring or agitation of the metal. Before operating the furnace, it is heated for 1 hour and then the metal charge of 4000 pounds is admitted. The average temperature of the cupola metal is about 250 degrees Fahr., and in 45 minutes that temperature is increased to 2750 degrees Fahr. in the furnace. Temperatures of 2900 degrees Fahr. have been reached in the furnace by holding for a longer period.

From 12 to 15 pounds of fused sodium carbonate supplied by the Mathieson Alkali Works, Inc., New York, is used for the charge of 4000 pounds of metal. The resulting iron tapped from the spout of the furnace, ranges from 0.010 to 0.038 per cent sulphur, and from 2.50 to 3.00 per cent total carbon, which can be controlled within 0.10 per cent. The metal for glass molds is made from pig iron and return foundry scrap and the usual carbon content is about 4 per cent.

Carbon Is Reduced

The foundry points out that the auxiliary furnace also enables it to produce a controlled analysis not only in respect to silicon, phosphorus, manganese and sulphur, but especially so in regard to carbon. Carbon may be reduced without the aid of any chemicals or foreign substance to as low as 2.00 in gray iron. No steel is used in the original cupola charge nor in the forehearth to accomplish this end, the carbon being reduced naturally through the action of the furnace.

The furnaces also enable the foundry to make high additions of alloys without any subsequent loss of temperature and assures the complete fusing of the alloy with the iron without segregation. Alloy additions as high as 30 per cent have been made with very satisfactory results. Silicon, manganese, phosphorus, chromium, nickel or any element desired may be added with a low oxidizing loss.

The cost of operation of this type furnace is exceedingly low. If it were in operation every day for an entire month, the fuel cost would not be over $120 for the entire period for a 2-ton furnace. Then too the original cost is exceedingly low and there are no mechanical or moving parts to make the operating cost excessive.

Compositions of glass molds vary considerably depending upon the section of the mold, and the service which it must withstand. Molds made by the Miller Foundry Co. contain copper and chromium in amounts which have been determined by experience to produce the desired qualities in the final castings. It is claimed that 5 per cent copper has been added experimentally to iron made in the furnace without evidence of metallic copper being found by carful microscopic examination. Both copper and chromium are added in the furnace, and an excellent recovery is obtained.

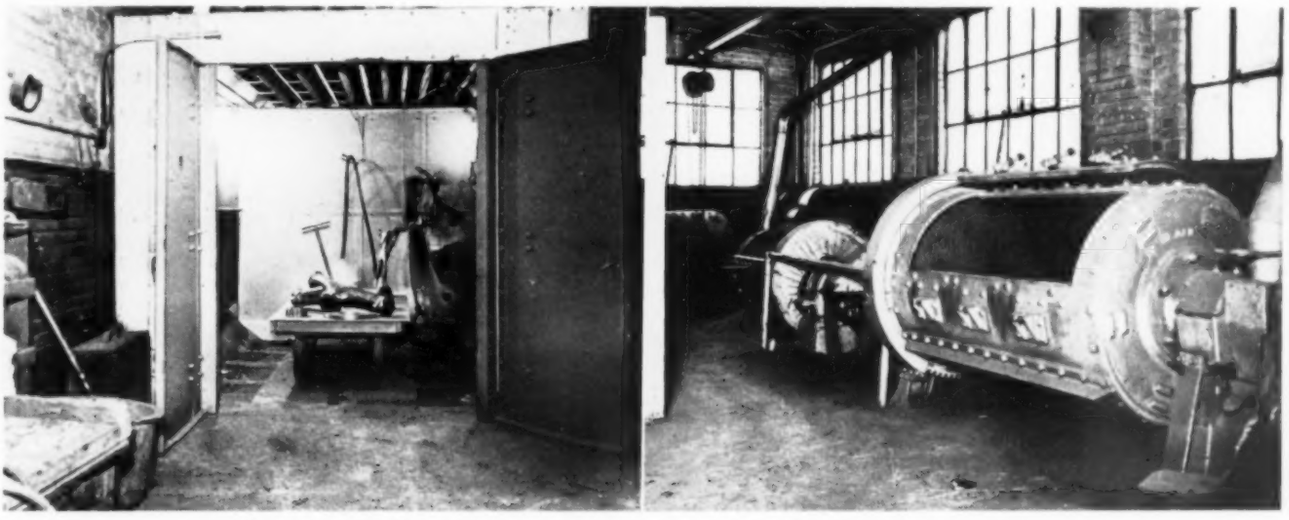
Fig. 4 shows a representative group of castings made by the Miller Foundry Co., including a number which are not glass molds. In general, the latter weigh from 20 to 240 pounds. Results obtained from castings made from metal treated in the new furnace are gratifying, particularly in the increased life of the casting. For example, in one large mold used for making glass cases for electric meters, the service was increased more than three times. The ordinary mold for that purpose usually can be used for about 12 hours before it has to have the scale removed from its surface. However, in the case of the specially treated iron the mold was used for 36 hours without descaling being necessary, and undoubtedly the service would have been longer but unfortunately the manufacture of the meter cases ceased at the end of that period.

Patents have been applied for on the furnace and the Miller Foundry Co., expects that some arrangement will be worked out so that the furnace will be available to the foundry industry.

Connecticut Group Elects Officers for 1936

Connecticut Nonferrous Foundrymen's association elected the following officers at a meeting held at the Hotel Garde, New Haven, Conn., Dec. 17: President, T. Joseph Judge, Jenkins Bros. Co., Bridgeport; vice president, H. A. Phelps, Phelps Foundry Co., Ansonia; treasurer, D. W. Case, Belknap Mfg. Co., Bridgeport; secretary, Louis G. Tarantino, 523 West Taft avenue, Bridgeport. The following executive committee was chosen: David Tamor, Reading, Pratt & Cady Co., Hartford, chairman; Ernest Stone, Consolidated Ashcraft Hancock Co., Bridgeport; George King, Malleable Iron Fittings Co., Branford; Fred Clarke, Whitehead Bros. Co., Providence, R. I., and G. F. Halpin, Seymour Mfg. Co., Seymour. Harold King, Jenkins Bros. Co., Bridgeport, was elected technician.

R. J. Heisserman, Link-Belt Co., Philadelphia, presented the feature talk of the evening on "Equipment Applied to the Nonferrous Foundry Industry". The next meeting will be held on Jan. 21.



Figs. 5 and 6—Castings are cleaned in a department separated from the remainder of a foundry by a brick wall. They are sandblasted or tumbled or both, depending upon the size and finish required

Bond Steel Molds with Cement

(*Continued from page* 32)

tain types of molds to which the new method has not yet been applied. The space formerly occupied by the first oven has been floored with cement on which many of the molds produced in the daily operation pass through the air drying stage. Part of this floor is shown in Fig. 7, while a wide miscellany of cores heavy enough to require crane service are shown in Fig. 8 on part of the floor in No. 1 bay of the foundry near one end.

For want of a more precise nomenclature the blocks of cement bonded sand still are referred to as cores, although as a matter of fact they correspond to the usual drag and cope of a mold. In the foundry, where so many shop terms are employed interchangeably, this reference to cores causes no confusion or misunderstanding. Conceivably, a person without foundry training or experience might find difficulty in reconciling the term *core* with a block of sand which forms the outer part of a mold, but until some purist arises and coins a new word, speakers and writers of foundry subjects will have to struggle along with the term core for any block of sand formed in a corebox, irrespective of whether the block eventually is placed on the inside or the outside of a mold.

Typical illustration of several features in connection with the method employed in making simple two part molds by the Randupson process is shown in Fig. 9. The castings from these molds are for the usual type conveyor erected in the vicinity of a blast furnace. As the molds pass in rotation they are filled from a stream of iron flowing at regulated speeds from the lip of a blast furnace ladle.

Patterns for the job are mounted on boards in the conventional manner, one set for the drags and a second set for the copes. A frame then is attached to each board and this frame converts the assembly into a corebox. The table on the molding machine has a slot across the face 1-inch deep and 4-inches wide and tapered at the sides for a dovetail fit. A corresponding strip on the bottom of the corebox enters this slot where it is held by a long narrow wood wedge, thus anchoring the box on the machine during the jolting operation. All boxes are fitted in the same manner, and thus may be changed readily. The method lends itself readily to jolt ramming.

Two small holes in each end of the cope pattern face, and corresponding small projecting members on the drag pattern face form the necessary guide pins and holes for assembling the two halves of the dried mold. The teats or pins are indicated clearly in the half molds at the left of Fig. 9, but the holes in the faces of the drag half molds to the right do not show.

These locating members are not used to any great extent. In the majority of instances the molds are closed accurately, simply by matching the outside edges. Accuracy of fit on the outside is sufficient guarantee of accuracy of fit on the inside.

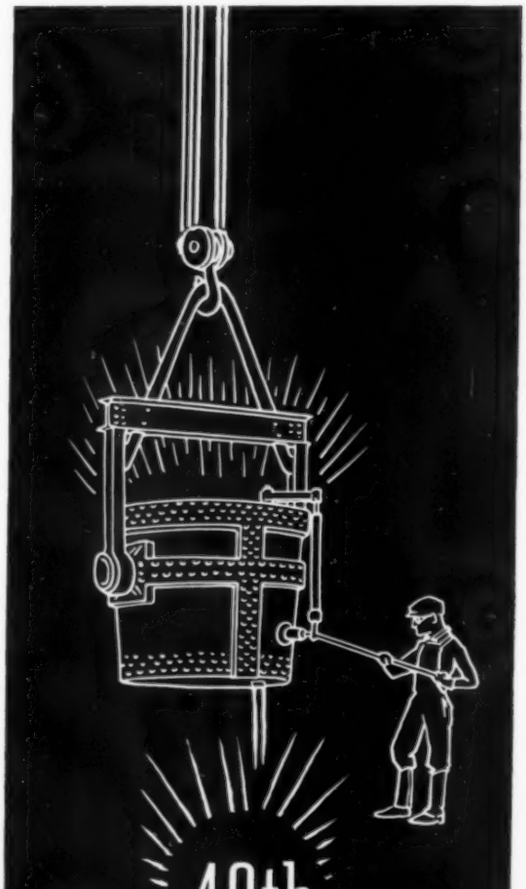
With the corebox anchored in place on the molding machine, a sufficient amount of prepared sand is shoveled in to not only cover the patterns, but also to line the sides of the box. Lifting hooks are placed in position followed by a quantity of cinders or reclaimed sand. The remainder of the box then is filled with a mixture of old or backing sand and cement and the mold is jolted. The remainder of the process follows ordinary foundry routine. The face of the mold is scraped off flat. A planed iron plate is clamped in place and the assembly is rolled over and placed upon a roller conveyor. The corebox is removed and replaced on the machine table while the core and plate are moved toward the end of the conveyor where they are removed by the crane and placed on the floor to dry. In approximately 12 hours the core has stiffened sufficiently to be turned up on edge for removal of the plate. In 12 hours more the cores are in condition to be assembled.

In clamping the half molds together, a spare clamp or a flat piece of steel is placed between the toe of the clamp and the body of sand. This feature is illustrated in Fig. 12 showing part of a floor of molds ready to receive the metal. The thickness of sand in the cope may be held to the minimum amount required to cover the pattern. Runners and risers are built to any

(*Concluded on page* 70)

Fig. 12—Molds in a wide variety of sizes and shapes are assembled and poured without the use of flasks or curbing of any kind. Cope and drag sand blocks are clamped together

Casting the 'METTLE' for a Greater 1936 Market



40th
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May 4 to 9, 1936

To tap the many millions in stored-up expenditures awaiting the purchase of immediate and necessary equipment for the Foundry Industry—will be the fundamental of the forthcoming Foundry and Allied Industries Exposition . . . *A release of mettle—an injection of spirit for a super-market in 1936.* Space reservations, fifteen days following formal announcements to prospective exhibitors, *greatly exceeded the total* space sold for the October 1934 Show in Philadelphia.

/ / / For details and floor plans regarding exhibition space, address

American Foundrymen's Association

222 WEST ADAMS ST. CHICAGO, ILL.

(*Concluded from page* 68)

required height in independent blocks of sand.

Early in the experimental work it was found that the usual type of shellac was not satisfactory on patterns or coreboxes in contact with cement bonded sand. Later an acetone paint was developed which successfully resists the action of the cement. This paint now is available in the United States where it is made by a prominent manufacturer according to the original French formula.

The flexibility of the sand-cement process in regard to pouring molds

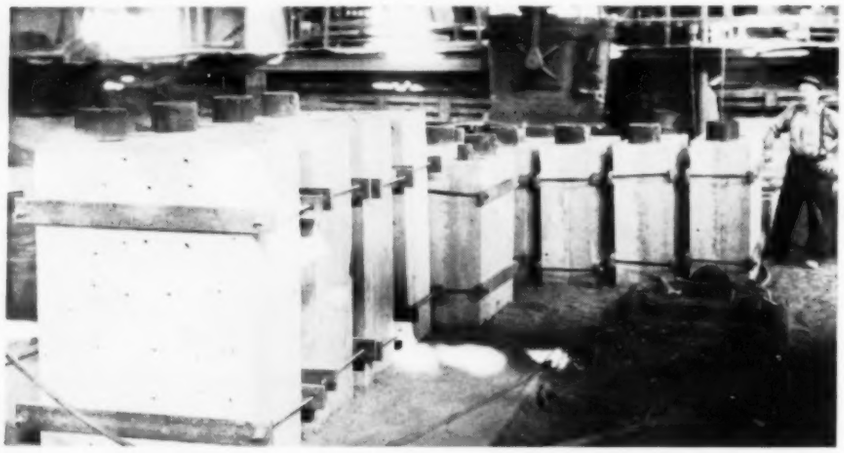


Fig. 13—Crosshead molds shown in Figs. 10 and 11 are clamped with bolts and straps and are filled with metal while in a vertical position

in any position is shown in Fig. 13 where a number of locomotive crosshead molds have been arranged to receive the metal while in a vertical position. Intermediate steps in the process are illustrated in Figs. 10 and 11. In Fig. 10 the half molds are shown in the position they occupied after the plates were removed. In Fig. 11 two molds to the right have been cored and closed, with the remainder of the group of cores shown in position.

This example also illustrates a method adopted in certain instances for forming the runner in a dry sand core instead of in tiles or in the block of sand of which the mold is composed. At the end destined for the bottom when the mold is upended, the runner discharges metal through openings in opposite sides of the core. These openings in turn coincide with gate passages formed in the mold body beside the dry sand core which forms the bearing face on the crosshead casting. The long runner core is placed in a suitable print in the mold, as shown to the left in the various half molds standing in Fig. 10.

Successive steps in the production of a sheet piler lever are shown in Figs. 1 to 6 inclusive. The casting is 31-inches high, 7 feet 8 inches wide and 34 feet 1-inch in length. A bottom plate and steel flask of suitable size were leveled on the floor and partly filled with broken material salvaged from former molds in the cleaning room. On large heavy castings where the metal remains a considerable time in the molten condition, a certain amount of the chemically combined water in the cement bonded sand is converted into steam, hence provision has to be made for the escape of this steam in a direction away from the casting. The rubble in the drag or in the bottom of the flask offers free passage for the steam to the openings in the bottom plate and in the sides of the flask. To further facilitate the escape of the steam a number of ¾-inch rods extending from side to side of the flask were laid in the rubble. These rods projected through the openings in the sides of the flask, and later were removed. In addition to providing a porous foundation, the broken material effected a material reduction in the amount of facing sand required in the mold.

Five straightedges with the upper edges level and parallel were erected on the rubble bed to serve as a guide in forming the bottom face of the mold and a foundation on which to erect the large number of cores that formed the remainder of the mold. This bottom or foundation was formed of facing sand rammed in the usual manner and then struck off with a straightedge riding on the others. Sand rammed around a flat templet laid on the bed formed the lower boundary of the mold and also served as a guide in setting the cores.

The second stage of construction is shown in Fig. 2, with chills bedded in the face under the anticipated position of the cross ribs, and with the first cores laid at one end. With the exception of the cover cores, the entire set of cores is shown in place in Fig. 3. Short pieces of scantling were jammed between the cores and the sides of the flask to insure rigidity when the mold was filled with metal. Additional rubble was packed between the cores and the sides and ends of the flask. The covering cores were placed in position with the risers projected upward in square cement-sand blocks containing the riser openings in the center.

Technical Program Carries Innovation

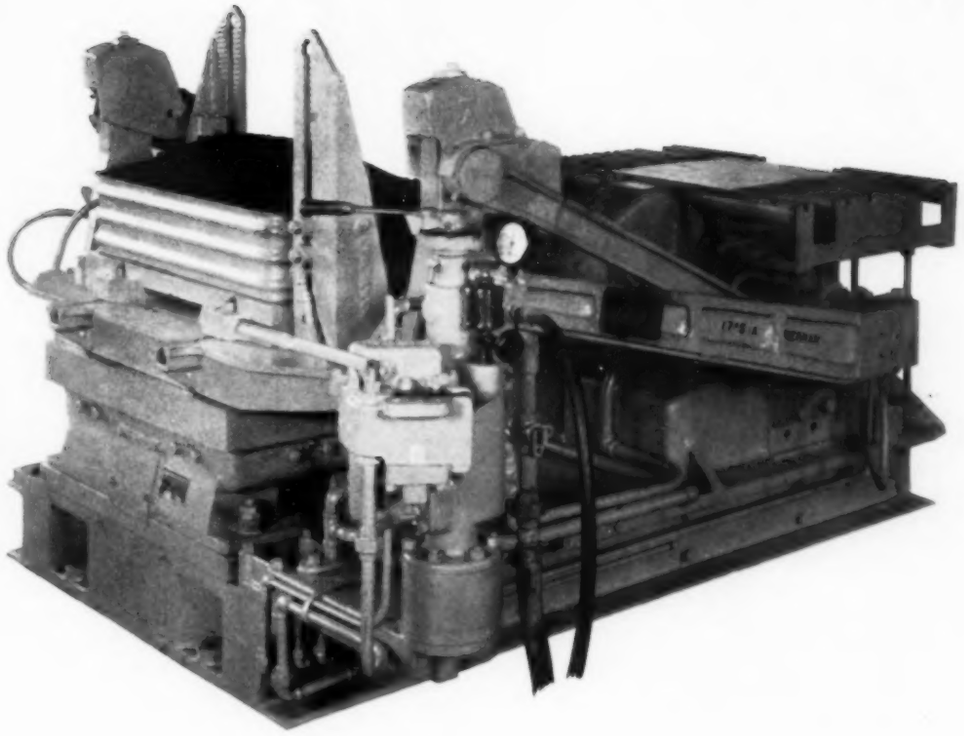
(*Concluded from page* 25)

foundry equipment, sand research, foundry refractories, and apprentice training. Dinner meetings followed by roundtable conferences will provide a new departure for the coming convention. Meetings are scheduled on steel, nonferrous metals and malleable iron. The steel discussion group will be under the chairmanship of A. H. Jameson, manager of castings sales, Malleable Iron Fittings Co., Branford, Conn. Mr. Jameson will be assisted by A. W. Gregg, works manager, Farrell-Cheek Steel Foundry Co., Sandusky, O.

The nonferrous division has chosen T. C. Watts, superintendent, Falcon Bronze Co., Youngstown, O., as chairman of the nonferrous roundtable conference. The committee members include Harold J. Roast, technical advisor, Canadian Bronze Co., Montreal, and H. J. Rowe, Aluminum Co. of America, Cleveland.

Two important shop operation courses are planned for the discussion of fundamentals of practical sand control and iron melting. The sand shop course, one of the popular features at conventions of the American Foundrymen's association during the past few years, will be in charge of the following committee: W. H. Spencer, foundry superintendent, Sealed Power Corp., Muskegon, Mich., chairman; Charles Schofield, Gray Iron Foundry division, Chevrolet Motors Co., Saginaw, Mich.; and Donald Yost, foundry metallurgist, Budd Wheel Co., Detroit.

The cast iron shop course is being organized by a committee consisting of P. T. Bancroft, foundry superintendent, Harvester works, John Deere Co., Moline, Ill., chairman; E. J. Carmody, cupola foreman, Campbell Wyant & Cannon Foundry Co., Muskegon, Mich.; Leslie G. Korte, superintendent, Riley Stoker Corp., Detroit; and Kenneth H. Priestley, metallurgist, Eaton-Erb Foundry Co., Vassar, Mich. Discussion leaders are being selected to present various phases of the many problems involved in melting cast iron.

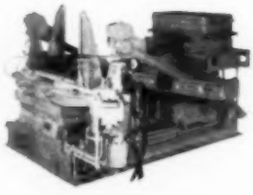


PITLESS TYPE HI-SPEED JARR ROLLOVER AND PATTERN DRAWING MACHINE

SIMPLE AS *A - B - C*

ROLLING OVER

DRAWING PATTERN



COMPLETED MOLD

Push the handle down. The mold is jarred to the required density and the machine stops itself. No need of counting the number of blows or of timing the jarring. Molds are instantly clamped and unclamped.

Move the rotary valve handle to the first position. The machine rolls over and automatically checks. There is no slamming, no jerky movement.

The next position brings the pattern draw up against the mold. It adjusts itself to irregularities of the bottom board or flask, then locks.

The next starts the vibrator and at the same time the mold is slowly drawn from the pattern.

Then to fast draw and exhaust. The finished mold is resting on the roller conveyor, the pattern is awaiting its next flask.

What could be simpler?

HERMAN PNEUMATIC MACHINE CO.

UNION BANK BLDG PITTSBURGH, PA.

Shows Cupola Melting Loss

(*Concluded from page* 34)

and gain.

Several years ago the problem was solved definitely by a large foundry corporation operating many plants in different sections of the country. Each foundry superintendent had his own ideas on what was good or bad cupola practice. Conflicting monthly reports came into the hands of the operating head and auditing department. One report would show a melting loss of 3 per cent, while another might show 10 per cent. No two would show the same loss or even near the same regardless of the fact that the equipment and product of each plant were the same.

After considering the matter of loss from every angle, and the best practical method to be pursued in gaining the actual facts and figures covering the subject, the corporation decided to inaugurate and carry out a series of tests on 20-ton heats, extending over a period of 6 months. The entire program was devoted exclusively to the establishment of actual cupola melting loss or gain, and the most practical method of cupola operation. These heats at the start were made entirely of pig iron. Later all the different classes and grades of iron and steel scrap that could be used in making iron castings were run separately.

At the plant when the tests were made the equipment included all necessary stock or raw material bins, a well planned yard, a three beam stock-scale mounted on a transfer car, a plentiful supply of charging trucks, two charging cranes that were not used, two cupolas lined to 48-inches, also a 3-beam scale mounted on a low car upon which was mounted a reservoir ladle, dry and wet magnetic separators and all other necessary equipment to carry on an operation of this kind.

Molds, necessary to care for 20 tons of iron were produced daily. Weighing the twenty 1-ton charges, was cared for by an experienced clerk who took the tare, gross and net weights and recording them in triplicate. The coke bed, having been properly lighted and raised to a proper height, the charging was all done and properly supervised. Supervision is absolutely necessary at all times during charging. The details were checked to this point and if found in order, the blast was turned on and delivered through a liberal total tuyere area, bearing a proper ratio to the cross sectional area of the cupola. The blast was controlled by a suitable volumetric gage, and delivered in the right volume. Tapping was in charge of an experienced cupola man. The metal then was tapped into a reservoir ladle. Tare, gross and net weights were taken and recorded by another weigh clerk.

Through Magnetic Separator

On the following day the cupola drop was removed to the cleaning room. After the cupola had been thoroughly picked out that material also was gathered carefully and removed to the cleaning room. All this material was put through the water barrel, and then over the magnetic separator. The weight of this recovered iron plus weight of the iron recorded at the spout represented the total weight of the iron passing through the cupola. Difference between total weight of iron charged into the cupola, and total weight of iron which passed through the cupola would be the loss or gain in the cupola.

Each of the following seven heats was made up of one class of material only. This procedure was followed to secure an accurate melting loss or gain on each class of material, as shown in the accompanying table. Consequently, anyone having these exact figures at hand for reference could form any combination of materials and estimate the melting loss or gain. The carbon pickup or gain in the steel minus the total of the pig and scrap loss leaves a net loss of 0.9997 per cent.

Iron Lost in Melting

		Per Cent
50 per cent machine cast pig	Known melting loss	0.003
25 per cent No. 1 Machinery scrap	Known melting loss	0.650
25 per cent Steel scrap	Known melting gain	1.65
		0.653
Total loss		0.9997

The first heat of 20 tons machine cast pig following the procedure outlined showed a loss of 0.003 per cent.

No. 1 machinery scrap, free from steel and broken into convenient cupola size for a 48-inch cupola showed a loss of 0.65 per cent.

Light machinery free from steel and malleable, 0.98 per cent loss.

Car wheel scrap, 0.68 per cent loss.

Clean stove plate, 2.75 per cent loss.

Old stove plate with some sheet steel and heavily oxidized showed a loss of 5.85 per cent.

A 20-ton heat of high carbon and mild steel, a gain of 1.65 per cent, due, according to analyses to increased carbon of 3 per cent.

Another heat, made up of 50 per cent pig and 50 per cent briquets composed of car wheels borings without binder showed a loss of 1.23 per cent.

In a heat of briquets alone, the loss was 2.01 per cent.

A heat of 75 per cent pig, 25 per cent car wheel borings packed in containers resulted in a loss of 3.01 per cent.

The containers were sections of black iron pipe about 18 gage, 12-inches diameter and 24 inches long, with a cap attached to one end of the first section by a couple of small rivets. Additional sections are joined in the same manner until a length is formed to reach from the top of the coke bed to the bottom of the charging door. The pipe is lowered into the cupola with the cap resting on the coke bed. The pipe is filled to the top with loose borings, using narrow scoops for the purpose. The remainder of the charging is done in the regular way, care being taken not to throw heavy stock against the pipe. As the charges descend, other pipe sections can be slipped on and filled in this way to the end of the heat.

The heats described were duplicated many times and a great many others made up of varying combinations of the different materials were run daily, over a period of several months. A check and recheck on all figures of former heats were made. Therefore, it should be understood that the figures given are correct, and are not based on theory, opinion or guess. Many of the leading authorities of the country were interested observers while these operations were being carried on.

There is nothing about any of these results that cannot be duplicated by any foundryman interested in such matters and who will devote some time to the details of operation. Any kind of cupola will do, providing it is properly operated.

ADVERTISING PAGES REMOVED

Sensible Quota for Apprentices

(*Concluded from page 29*)

my shop at all times."

Well, that too can be worked out. We assumed before that out of ten beginners, two leave in the first year of apprenticeship, and one later on but before graduation.

If two leave in the first year, you have ten apprentices on hand at the beginning of the year and eight at the end of the year, and the average employed during the year is clearly nine.

And if one leaves some time during the remaining 3 years, then one third leaves each year, in theory. Therefore, you have eight apprentices at the beginning of the second year, seven and two thirds remain at the end of the year, and you employ an average of seven and five sixths during the year.

If you make similar calculations for the third and fourth years, your total of employment quota *for each ten starters* is as follows:

First year men	9
Second year men	7 5/6
Third year men	7 1/2
Fourth year men	7 1/6
Total	31 1/2

But your starting quota is 22 per year. The number of apprentices you must carry is therefore 2.2 times 31.5, and that amounts to 69.3, or whenever you graduate or lose an apprentice you hire another.

From this corps you may expect 13 graduates every year, eight for replacement and five to make up your original shortage. When your shortage is made up, and you need only eight graduates per year instead of 13, the 70 apprentices may be reduced, in the same proportion, to 43.

Obviously, to keep up a steady procession of graduates, you should take in the 70 apprentices over a 4-year period and not all at once.

Obviously, too, you cannot adhere too rigidly to these quotas. For instance, if an exceptionally promising boy comes along, you will hire him even if your quota is filled. On the other hand, you will get along with less than the quota for a time if no good applicants present themselves. Besides that, you will need to take industrial conditions and other significant trends and circumstances into account.

Your next question probably is "Where do I get my correction factors if I'm just getting started and have never had apprentices in my plant?" Try some of your neighboring competitors who have been at it longer, or try the figures in this article, or start out by hiring twice as many boys every year as you need graduates per year and then develop your own factors by experience.

And since there will be enthusiasts in your shop who will complain that you don't train enough apprentices, and chronic obstructionists who will howl about training too many, it might be good to assemble your department heads and foremen, get a blackboard and some chalk and show them just how you compute your quota.

All these figures and calculations may seem a little complex but the whole method is nothing but ordinary common sense. You train as many apprentices as you need graduates, with enough in addition to take care of losses — and you actually determine your needs, and your loss percentages, instead of taking a flying guess.

Formed Tubes Cast in Gray Iron

(*Concluded from page 35*)

pyrometer. Eight large gates on each casting allow the casting to be poured quickly without flowing much metal over any paint in the tube. This precaution is important, as otherwise the tube is melted through and the entire job ruined by breaking down the insulating layer of magnesium oxide.

Northern California Chapter Meets

A. G. Suydam, sales representative, Harbison-Walker Refractories Co., Pittsburgh, presented an interesting paper at the second meeting of the Northern California chapter of the American Foundrymen's association held Dec. 13 at the Plaza hotel, San Francisco. Mr. Suydam spoke on "Refractories as They Pertain to the Foundry Industry" and illustrated his talk with motion pictures.

Officers and directors of the recently organized Northern California chapter are as follows: Chairman, C. M. Henderson, H. C. Macaulay Foundry Co., Berkeley, Calif.; vice chairman, C. J. Hoehn, Enterprise Foundry Co., San Francisco; secretary-treasurer, George L. Kennard, Pacific Coast Founders' association, San Francisco; directors, Robert Berry, Berry's Foundry, Sacramento, Calif.; J. L. Blackie, American Foundry Equipment Co., Oakland, Calif.; J. D. Fenstermacher, Columbia Steel Co., San Francisco; F. G. Johnson, American Foundry Co. Inc., Alameda, Calif.; F. A. Mainzer, Pacific Brass Foundry of San Francisco; W. J. Mulcahy, Metallurgical Laboratories, San Francisco; E. M. Welch, American Manganese Steel Co., Oakland, Calif.; and W. W. Young, Stanford university, Palo Alto, Calif.

The chairman has appointed the following committee chairmen: Membership, A. W. Allen, San Francisco Stove Works, San Francisco; program, E. M. Welch, American Manganese Steel Co., Oakland, Calif.; reception and entertainment, J. D. Fenstermacher, Columbia Steel Co., San Francisco; and publicity, G. L. Kennard, Pacific Coast Founders' association, San Francisco.

Cleveland Meeting On Pearlitic Malleable

A technical meeting featuring "Pearlitic Malleable Iron" will be held at the Cleveland club, Cleveland, Jan. 27, under the sponsorship of the American Society for Testing Materials, Cleveland district committee. A dinner, which will precede the technical session, is scheduled for 6:30 p.m.

The paper to be presented, covering the production, properties and uses of pearlitic malleable iron, has been prepared from material supplied by various sources directly interested in the production or use of that material. The program committee, appointed by Dr. H. A. Schwartz, chairman of the Cleveland district committee, and manager of research, National Malleable & Steel Castings Co., Cleveland, consists of the following: H. M. Boylston, chairman, professor of metallurgy in charge of the department of metallurgical engineering, Case School of Applied Science, Cleveland; Dan M. Avey, editor, THE FOUNDRY, Cleveland; Henry Chandler, assistant to president, Vanadium Corp. of America, Cleveland; R. E. Kennedy, technical secretary, American Foundrymen's association, Chicago; Fred L. Wolf, technical director, Ohio Brass Co., Mansfield, O., and Frank G. Steinebach, managing editor, THE FOUNDRY, Cleveland.

Invitation to the dinner and meeting is extended by the Cleveland committee to all interested in the subject of pearlitic malleable iron. Invitations are being sent to members of the Cleveland chapter of the American Foundrymen's association, the American Society for Metals, the Cleveland Engineering society and other groups.

The second annual welding conference, held under the auspices of the Texas Technological college, will be held at Lubbock, Texas, Feb. 13 and 14.

Gray Cast Iron (*Chapter VI Continued*)

(*Continued from page* 37)

strength and hardness it is reasonable to expect that molybdenum decreases machinability, although not necessarily in proportion to the increases in strength and hardness.

It has been claimed that molybdenum increases liquid shrinkage and molybdenum irons require heavier feeding than ordinary gray irons.

Boegehold's work—American Society for Testing Materials, *Symposium on Developments in Automotive Materials*—1930—suggests that the addition of molybdenum may cause some increase in coefficient of expansion. However, the test data are not sufficient to enable exact comparisons to be made.

In amounts employed, (0.25 to 1.50 per cent) molybdenum apparently has little influence on the general corrosion resistant properties of cast iron.

It is well known that molybdenum steels are sluggish in their response to heat treatments, the various transformations proceeding more slowly than is the case with many other steels. The author and others have noted that as little as 0.6 per cent molybdenum addition may cause oil hardening cast steels to become air hardening, that much higher temperatures are required to break up casting structure, and creep properties are considerably enhanced.

Similar effects are noted when molybdenum is added to cast irons. MacKenzie, in Fig. 90, presented in *Alloys of Iron and Molybdenum*, prepared a 10-inch diameter test bar, and a 2.20-inch test bar from the same molybdenum bearing iron. He cut some six 2.20-inch bars from the 10-inch bar found these nearly equal in strength and but slightly lower in hardness than the separately cast bar. This and the results of other investigators indicate that molybdenum increases markedly the quasi-isotropy of cast iron, that is, molybdenum additions promote uniformity of strength and hardness over a range of section sizes.

Tests made at Battelle Memorial institute, Columbus, O., indicate that additions of 0.83 per cent molybdenum increase the load that can be sustained at 700 degrees Fahr. without creep.

The work of Mussatti and Calbiani—*La Metallurgia Italiana*, June 1930—indicated that 1.5 per cent molybdenum addition markedly decreased tendency toward growth at 1472 degrees Fahr. over a 24 hour period, but over a 100 hour period little difference was discernible between the molybdenum containing and molybdenum free irons.

For temperatures above the eutectoid it is doubtful if molybdenum increases growth resistance materially, although there is some reason to believe that the carbide stabilizing tendencies of molybdenum may hinder growth in the range of say 800 to 1100 or 1200 degrees Fahr.

It would be expected that molybdenum additions would be beneficial in cast irons to be subjected to heat treatment. Some stabilization of carbides would prevent excessive graphitization, and the retardation in transformation rates would prevent rapid volume changes and permit utilization of more mild quenching media.

Although a comparative newcomer, molybdenum has proved a useful alloying element, both when added to nonalloyed cast iron of suitable compositions and when used in combination with other alloying elements. Further research and comparisons are needed before its limitations and complete range of usefulness can be ascertained.

*The early work of Moissan—*Bulletin Societie Chimique de France*, series 3, v. 13, pages 966-972, 1895 and C. R. Academy of Science vol. 120, pages 693-694—1896—established the existence of a prismatic compound containing about 5.5 per cent carbon. This apparently indicated formation of a carbide Mo_2C, which theoretically should contain 5.88 per cent carbon. The material had a density of 8.9.

Westgren and Phragmen—Zietschrift fuer Anorganische Chemie, vol. 156, pages 27-36, 1926—found that alloys of this approximate composition contained molybdenum atoms in a hexagonal close packed arrangement, but did not consider the existence of Mo_2C proved. Lester found that the alloy corresponding with the formula Mo_2C had the type lattice determined by W. and P., with the following parameters a 3.023 A°, c 4.746 A° and c/a 1.570 A°. The measured density was 8.88 and the calculated 8.91. The work of Takei on the molybdenum system also indicates formation of the compound Mo_2C.

Table VII

Effect of Molybdenum Additions on Cast Irons

	Piwowarsky 0.5 per cent molybdenum	Smalley 1.5 per cent molybdenum cylinder iron	Smith & Aufderhaar 1.5 per cent molybdenum	Musatti and Calbiani 1.5 per cent molybdenum
Tensile	plus 60	plus 25	plus 67	plus 75
Transverse	plus 35	plus 9	plus 57	plus 75
Compression	plus 30	plus 22		plus 100

Effect of Aluminum

ALUMINUM is comparatively soft white metal of low melting point, 1220 degrees Fahr. and low density, 2.70. It is a good deoxidizer and is rather widely used for that purpose in steel castings manufacture. The apparent deoxidizing and degasifying action of small additions of aluminum in both white and gray irons has been noted by a number of investigators.

Additions of sufficient percentages of aluminum in the cast iron alloys result in decrease in total carbon content, the excess being rejected as kish. This suggests that aluminum probably lowers the carbon concentration of the eutectic.

In amounts up to a maximum of about 7 or 8 per cent, aluminum reduces the stability of cementite and thus promotes graphitization. Maximum graphitization rate apparently is attained at about 2 to 4 per cent aluminum. As with silicon the influence on graphitization depends on the carbon content of the iron and other factors as well as on the percentage added. In the ranges where it is most effective aluminum has from about one third to one half the graphitizing power of silicon.

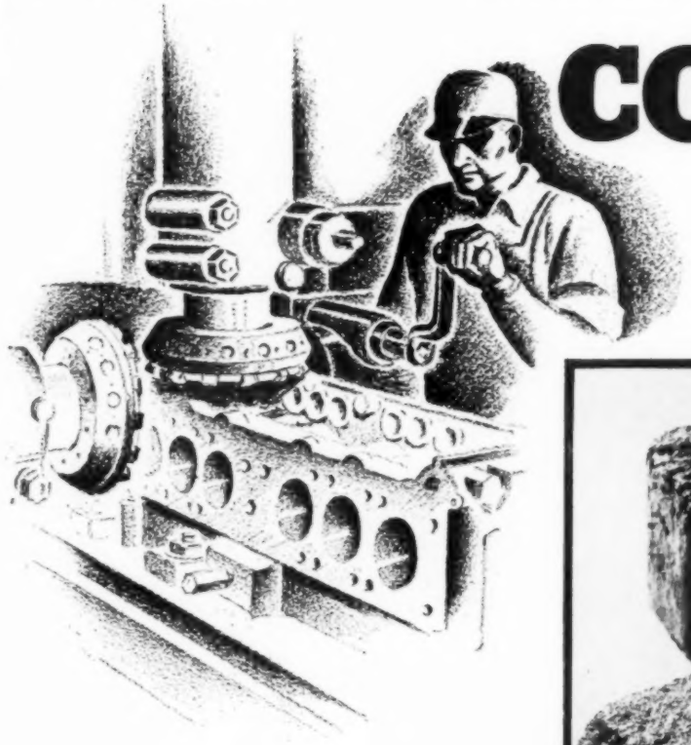
Aluminum increases the carbon content of the eutectoid (pearlite). In high carbon steel it was found that a pearlitic structure was obtained at 1.31 per cent combined carbon, in presence of 1.30 per cent aluminum. Aluminum additions also raise the temperature of the eutectoid transformation.

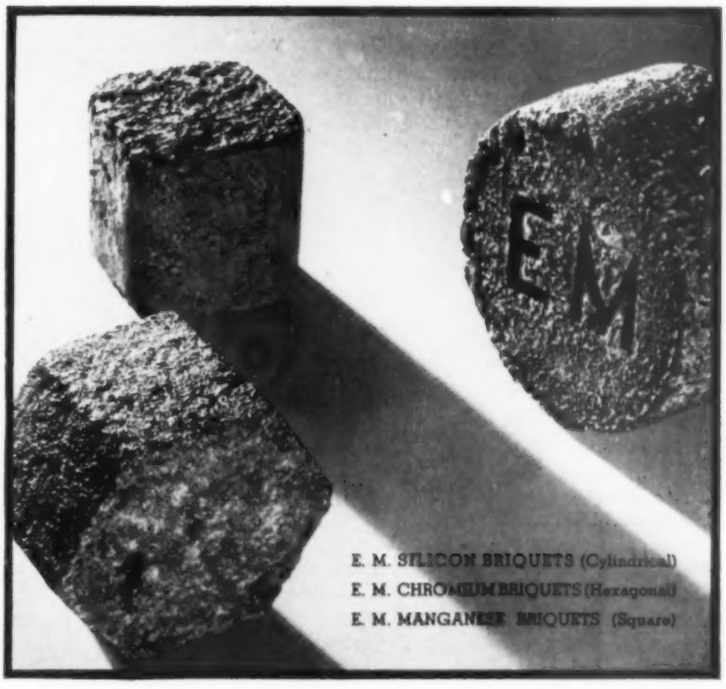
With aluminum content of above 8 and up to 18 per cent a hard and brittle range is encountered and all the carbon is retained in the combined form. Above 18 per cent and up to 25 per cent graphitization again occurs.

When aluminum additions are made to cast iron some of the aluminum is oxidized to alumina, and is

(*Continued on page* 78)

Reduce MACHINING COSTS





THE machine shop superintendent of a leading automobile manufacturer is enthusiastic about the way that E. M. Silicon Briquets insure better machining qualities in cast iron. His department is allowed a certain budget for machining. With their old mixture, a hardness of 180 Brinell was about the limit of ready machinability. This limit has been raised to 200 Brinell since an E. M. Briquet mixture has been adopted. E. M. Silicon Briquets not only help the machine shop keep within its budget, but also make better iron.

E. M. Silicon Briquets for cupola addition insure high and uniform recovery of the contained silicon. Thorough solution of the alloy is obtained. This method of adding silicon is accurate, economical and convenient. Time is saved. Off-iron is eliminated. Better castings are produced at lower cost.

Electromet Metallurgists will gladly explain the advantages of E. M. Briquets in your foundry. A request today will bring you complete information.

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27-L

(*Continued from page 76*)

found as inclusions. For this reason the actual aluminum alloyed in the metal is less than that added. Aluminum affects graphitization in two ways, namely, through deoxidation and through solution in the metal. Due to its ready tendency toward oxidation it is questionable whether cupola additions would result in retention of appreciable amounts or percentages of dissolved aluminum. For the same reason high aluminum cast irons are subject to bad dross formations and it is hard to obtain sound castings. The author has found that 20 per cent aluminum irons, crucible melted, cast into green sand molds were entirely covered with white alumina and graphite and were brittle and unsound.

The use of 1.00 to 1.75 per cent aluminum as a constituent of nitriding cast irons is described in an article on "Heat Treatment of Gray Cast Iron," appearing in THE FOUNDRY for August and September, 1934.

Recapitulating, aluminum is essentially a graphitizing element, particularly up to 4 or 5 per cent. In this role it is from 33 to 50 per cent as effective as silicon. The exact mode of occurrence of aluminum dissolved in cast iron is not known. It has been claimed that it may enter into solid solution as Fe_3Al_2. In high percentages various phases have been recognized but their constitution has not been established. In nearly all cases some alumina (aluminum oxide) inclusions are found.

Successive additions of aluminum, tend to decrease the carbon content, increase the carbon content of the eutectoid, raise the eutectoid transformation temperature, and apparently decrease the size of the graphite flakes. In small percentages, say in the range 0.10 to 0.25 per cent, aluminum has a deoxidizing influence, with consequent benefit to fluidity and indirect as well as direct effect on graphitization, depending on the oxides present. From there up to about 8 per cent aluminum is essentially a graphitizing element, the maximum effect occurring at about 2 to 4 per cent aluminum. Above 8 per cent to about 18 per cent it inhibits graphitization quite effectively, a brittle product resulting. Above 18 per cent up to 25 per cent it again exerts a graphitizing influence. Above 25 per cent the alloys are readily susceptible to atmospheric oxidation. Aluminum bearing irons are hard to cast clean, the difficulties increasing with increase in aluminum content.

Various tests indicate that although good mechanical properties can be attained by judicious employment of aluminum, similar results generally can be obtained more simply by other expedients. For special purposes, for example, in nitriding irons, aluminum additions can be employed advantageously. There an aluminum nitride is formed. Partridge—Journal Iron & Steel Institute, September 1925—has shown an unusual effect of 1 to 3 per cent aluminum in annealed iron, a marked increase in induction and permeability being noted.

References

1—Keep — *Transactions*, American Institute of Mining and Metallurgical Engineers, Vol. 18, 1889.
2—Hogg—*Journal* Iron and Steel Institute No. 2, page 104, 1894.
3—Melland and Waldron—*Journal* Iron and Steel Institute, Vol. II, 1900.
4—Gwyer—*Zut. Anorg. Cheima.* Vol. 57, page 129, — 1908.
5—Moldenke—*Principles of Iron Founding*, 1917 and 1930.
6—Kurnakow-Grigorjew—*Stahl und Eisen*, Vol. 43, page 850, June 28, 1923.
7—Partridge — *Journal*, Iron and Steel Institute, September, 1925.
8—Everest — *Foundry Trade Journal*, pages 169-173 — Aug. 25, 1927.
9—Everest — *Foundry Trade Journal*, pages 208-210, Dec. 22, 1927.
10—Sohnchen and Piwowarsky — *Archiv. fur Eisenhuttenwesen* — Vol. 5, pages 111-121, Aug. 1931.
11—Sirovich — *Giesserei mit Giesserei Zeitung*, Vol. 18, page 867, Nov. 6, 1931.
12—Sirovich — *La Metallurgica Italiana*— Vol. 10, pages 83-98, February 1932.
13—Reed — *Transactions*, American Society for Steel Treating, Vol. 20, No. 2, page 154 — 1932.
14—Piwowarsky and Sohnchen — *Metallwirtschaft*, Vol. 12, July 21, 1933, pages 417-421.
15—Marcel Ploye — *Revue de Metallurgie*, June 1935.

Effect of Arsenic

SMALL amounts of arsenic are found in some pig irons. This element has the following properties: Atomic weight, 74.96; melting point, 1562 degres Fahr., and density, 5.73. It is quite likely that arsenic if present in appreciable amounts is largely oxidized, volatilized or slagged off during cupola melting.

Arsenic up to 0.1 per cent apparently has no bad effects—Friedrich, *Metallurgie*, vol. 4, page 129, 1907. Up to 0.25 per cent arsenic retained from 1 per cent added has little appreciable effect,—Spencer and Walding, *Transactions*, A.F.A., vol. 40, 1932 pages 504-505.

The addition of ferroarsenic apparently acts differently than addition of metallic arsenic, particularly in low carbon iron, wherein additions of 0.25 per cent arsenic (0.11 per cent retained) resulted in marked increase in hardness and rigidity, and lowered transverse strength and impact resistance. However, greater additions of ferroarsenic (1 per cent) to the same type iron had little effect, although the retained arsenic was 0.14 per cent (Tests of Spencer and Walding). The apparent anomalies have not been satisfactorily explained.

Piwowarsky and co-workers have added arsenic up to 2 per cent. They conclude that the degree of graphitization and the flake size are unaffected by that element. Up to 1 per cent strength properties are unchanged. Acid resistance is somewhat increased, whereas resistance to caustic solutions apparently is decreased.

References

1—Friedrich—*Metallurgie*, vol. 4, page 129—1907 (FeAs diagram).
2—Piwowarsky—*Hochwertiger Grauguss* — page 288, — 1929.
3—Spencer and Walding — *Transactions*, American Foundrymen's Association, vol 40, pages 504-505.
4—Piwowarsky—Vladescu and Nipper — *Archives fur Eisenhuttenwesen* — Vol. 7, pages 323-327, — 1933.

Illinois Group Holds Christmas Party

The annual Christmas party of the Northern Illinois Foundrymen's association was held at the Elks club, Rockford, Ill., Dec. 10. C. A. Nass, Fairbanks, Morse Co., Beloit, and vice president of the association, presided in the absence of H. S. Bennethum, president. Seventy-five members were served a fine dinner, with entertainment and music supplied during and after the dinner hour.

C. M. Dale, Liberty Foundries, presented G. J. Landstrom, Sundstrand Machine Tool Co., retiring secretary and treasurer, with a traveling bag, on behalf of the association, for his fine work since the inception of the organization.

F. A. Jensen, William H. Nichols Co., Long Island, N. Y., presented an interesting address entitled "Russian Foundry Experineces." Mr. Jensen sketched his early life in Denmark and the United States, leading up to the time he was placed in charge of a foundry project in Russia. He described the work being undertaken there and emphasized the trend toward complete mechanization of foundries. Mr. Jensen also compared Russian and American foundry methods and equipment.

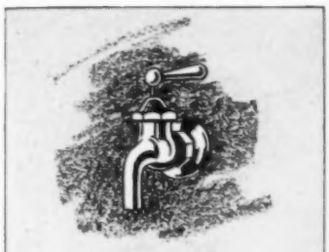
F.E.M.A. To Hold Meeting in Cleveland

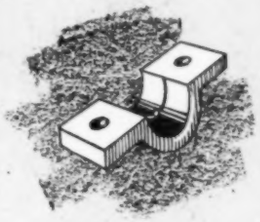
The annual meeting of the Foundry Equipment Manufacturers' association will be held at the Cleveland hotel, Cleveland, Feb. 8, according to an announcement of Arthur J. Tuscany, executive secretary.

In addition to reports of officers for the past year, the election of three directors, and other regular business, consideration will be given to plans for a broadened activity of the association occasioned by the increased demand for foundry equipment.

The detailed program will be announced later. All manufacturers of foundry equipment are invited to attend.

ECONOMY CONTROL and FLEXIBILITY in *Melting*


BRASS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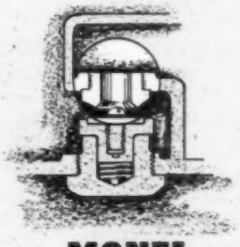
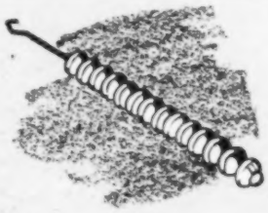

MONEL

COPPER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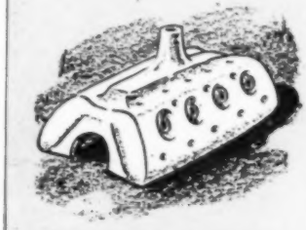
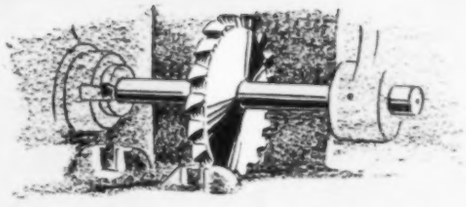
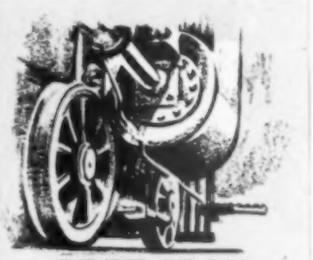
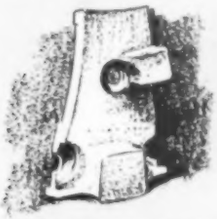

ALUMINUM

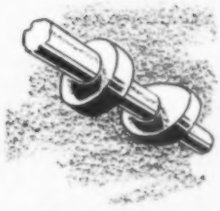
DETROIT *Electric* FURNACE CO.
825 West Elizabeth St DETROIT, MICHIGAN


HIGH CARBON STEEL

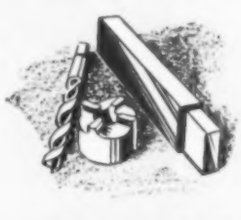

GRAY IRON

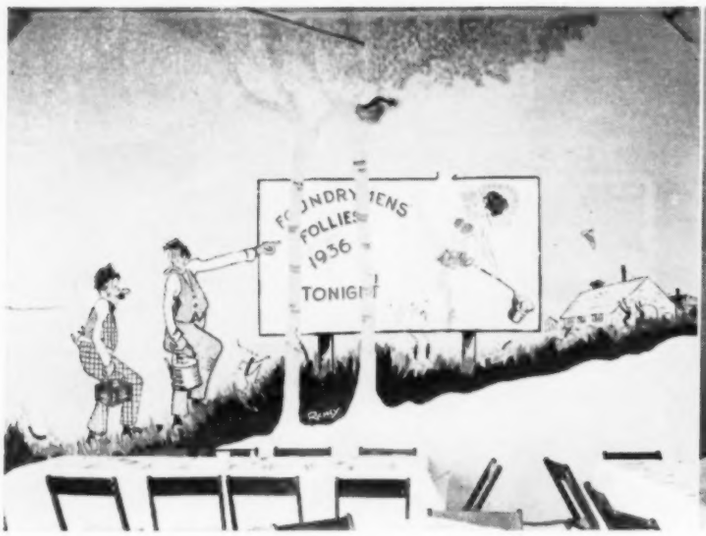
MALLEABLE


WHITE IRON


ALLOY IRON

STEEL


TOOL STEEL



Designs prepared by Harry L. Richey, creator of the "Bill" story cartoons appearing in each issue of The Foundry. The designs were displayed at the Northeastern Ohio chapter party. The painting at the left covered a large section of the wall near the stage, and the model at the right shows modern foundry practice as it should be executed

Ohio Chapter Holds Christmas Stag Party

The Northeastern Chapter of the American Foundrymen's association held its first annual Christmas stag party in the club rooms and theater in the Penton building, home of THE FOUNDRY, on Dec. 12.

Approximately 325 members and guests were present for the dinner and the fine vaudeville show which featured the entertainment of the evening. The show was presented through courtesy of equipment and supply manufacturers in the district and was arranged by a committee under the charmanship of L. P. Robinson, sales manager, Werner G. Smith Co., Cleveland. Edwin Bremer, metallurgical editor, THE FOUNDRY, was chairman of the dinner committee.

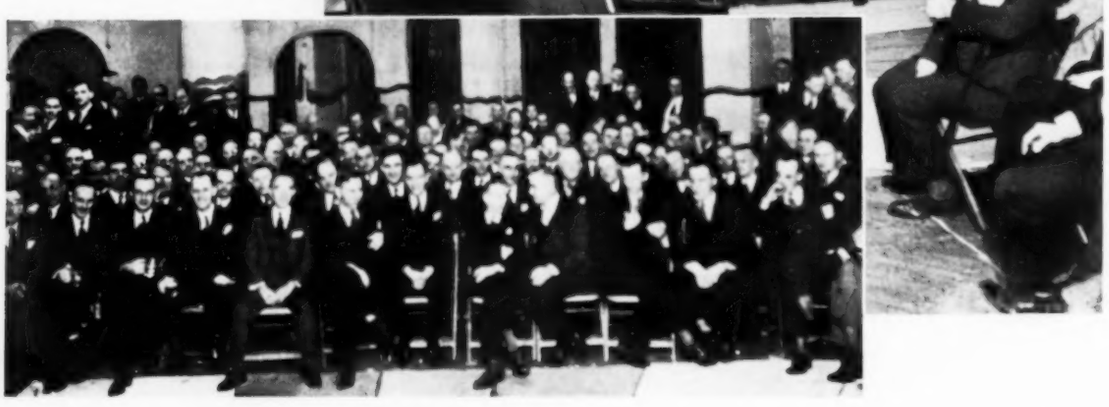
The meeting scheduled for Feb. 20 will present a cost clinic featuring a discussion by Albert E. Grover, cost consultant, Berea, O.

Publishes Appendix To Minerals Yearbook

Bureau of mines, U. S. department of interior, Washington, recently published a supplement to the 1934 *Mineral's Yearbook*, entitled, "Statistical Appendix to Mineral's Yearbook, 1934." The publication contains information not completely available at the time of the publication of the *Yearbook*. The present volume contains 434 pages, and includes 15 chapters of final statistics on lime; gold, silver, copper, lead and zinc in Nevada; sand and gravel; stone; cement; gold, silver, copper, lead and zinc in Idaho; natural gas; ore concentration; gold, silver, copper, lead and zinc in Arizona; gold, silver, copper, lead and zinc in California; crude petroleum and petroleum products; coal; natural gasoline; gold, silver, copper, lead and zinc in Montana. Copies of the book may be obtained from the superintendent of documents, Washington, for $1.

Enlarges Quarters

National Foundry Sand Co., Detroit, has moved into larger quarters in the same building, 2970 West Grand boulevard. The move has been necessitated by increased business.



Some of the crowd surrounding the dance floor just before the show went on

ADVERTISING PAGES REMOVED

Welders Learn About Casting Progress

Progress in castings manufacture was stressed Dec. 11 at a session of the Cleveland chapter of the American Welding society, of which A. E. Gibson, Wellman Engineering Co., Cleveland, is chairman. Mr. Gibson paid tribute to the advance made in castings manufacture during the past 10 or 15 years. At the beginning of that period Navy specifications for gray iron called for 18,000 pounds per square inch tensile test. At present high strength castings regularly are produced and used in the manufacture of heavy machinery which show 50,000 pounds per square inch tensile and 500 brinell hardness.

Maj. R. A. Bull, Chicago, steel foundry consultant addressed the session on steel castings. Recent advancements are typified by 25 different A. S. T. M. specifications for alloy steel of which 12 have been established since 1932 and of these, nine were specified in 1935.

The flexibility attainable in meeting various requirements in steel castings production, is due to wide use of electric furnaces. About 165 plants making steel castings now employ this melting medium. They can produce steel ranging from 75,000 to 150,000 pounds per square inch tensile with yield points within the range of 40,000 to 125,000 pounds per square inch.

Special alloy steel castings are available to meet practically every engineering requirement. Twelve A.S.T.M. grades embrace high alloys, many corrosion resistant, not including the 18 and 8 series. Eight compositions for high temperature service for the oil and power industries are typical of such special products. No less than 75 different grades of carbon and alloy steel are being manufactured regularly by American steel castings plants.

The speaker mentioned the availability of combination structures employing steel castings to provide the more complicated portions of engineering structures to which simpler forms of rolled materials may be welded. The economy of such combination structures is influenced by the number of pieces required and designs are possible in castings that would not be obtainable by other means, particularly where it is necessary to support stress in all directions.

In discussing the metallurgy of steel castings and drawing inferences as to adaptability to welding, the speaker cautioned against acceptance of old theories. It is impossible to forecast definitely the effect of various alloying agents, unless the influence of all other factors is considered. For example, relatively large amounts of phosphorus may be present and not injurious, when carbon is low. Copper additions are being used up to 2 per cent depending upon the proportion of other elements. Recent studies indicate the influence of aluminum on grain structure and even sulphur is not always deleterious.

The speaker stated that both welded structures and castings now are giving splendid service. Preconceived prejudices against castings on the grounds of shrinkage, dirt and other conditions have been overcome by progress in foundry practice. The dollar value, sound economics should control selection of the proper design to meet specific requirements.

Developments in high strength gray iron castings were outlined by A. C. Denison, Fulton Foundry & Machine Co., Cleveland. He noted revisions in gray iron specifications largely made at the demand of the producers. He disapproved the use of the term *high tensile* as applied to materials now readily available in gray iron castings, explaining that while glass may develop as high as 40,000 pounds per square inch tensile, it is brittle and not available as an engineering material.

Therefore, modern gray iron should be characterized as *high strength*. Strength is determined by the crystal structure and is attainable by special control methods either involving alloys or as in the case of meehanite made by Mr. Denison's foundry, by the addition of calcium silicide to a mixture giving the hypo-eutectic structure. Numerous examples of high strength materials, with the tensile, transverse, hardness and other properties demonstrated by tests and comparative micrographs, were shown by Mr. Gibson.

Albert Williams, welding engineer, Wellman Engineering Co., presented a paper on welding of high strength materials. He dealt with various new alloys including copper-bearing steels which had been mentioned by previous speakers.

Availability of Raw Materials Studied

The office of the division engineer, North Pacific division, corps of engineers, recently has completed a report entitled "Available Raw Materials for a Pacific Coast Iron and Steel Industry". The report, prepared by Dr. Edwin T. Hodge, is a resume and analysis of present available information on suitable domestic and foreign supplies of ores, fluxes, etc.

Copies of the report may be seen at the office of the division engineer, North Pacific division, 523 Pittock block, Portland, Ore.; at the office of the Regional Planning commission, 220 U. S. court house, Portland; Oregon State Planning board, 802 Spalding building, Portland; at the public library, Portland; or may be obtained from the office of the division engineer, North Pacific division, Portland, for $1.25 per volume. The work is divided into four volumes.

Plan Joint Foundry Meeting for Birmingham

Birmingham section of the American Society of Mechanical Engineers and the American Foundrymen's association, are planning a joint foundry meeting for foundrymen and engineers in the Birmingham district. The meeting, which is tentatively scheduled for Feb. 27 and 28, will be held in Birmingham, Ala.

The program probably will include a discussion of sand control, a paper on the use of alloys in iron, and a talk on grinding castings.

Those co-operating in the meeting include: Joseph W. Eshelman, chairman of the Birmingham section of the A.S.M.E.; L. N. Shannon, Stockham Pipe & Fittings Co.; Dick Deas, American Cast Iron Pipe Co.; and Thomas J. Carpenter, Republic Steel Corp.

Further details in the program will be presented in the February issue of THE FOUNDRY.

A.S.M. Chapter Hears Talk on Steel Castings

F. A. Melmoth, vice president in charge of operations, Detroit Steel Castings Co., Detroit, presented an interesting and valuable discussion on "Steel Castings: Their Production, Treatment and Application" before the Cleveland chapter of the American Society for Metals on Jan. 6. Discussing the subject of design, Mr. Melmoth stated that the curse of the foundry industry is orthodoxy of design. Generally speaking, all designs are capable of improvement from the castings standpoint.

The speaker referred to the work on solidification which has been presented in paper form during the past several years before the annual meetings of the American Foundrymen's association. Reference was made to the size of the steel castings industry, which in the ten year period from 1920 to 1929 produced in excess of 1,000,000 tons of steel castings annually.

Mr. Melmoth pointed to four things which are essential in the successful production of good steel castings. These are regularity of analysis, temperature control, freedom from gases, and freedom from excessive amounts of nonmetallic inclusions. The speaker mentioned the various types of furnaces used in melting, and stated that recently in England he witnessed successful melting operations in a powdered coal fired rotary furnace of the low pressure type.

We are just at the beginning of the alloy age, according to Mr. Melmoth. Application of research to the steel foundry industry has been enormous during the past ten years and much remains to be done. In discussing the subject of structures, the speaker illustrated with slides and charts the effects of heat treatment.

Obituary

ARTHUR WILLIS WALKER, 75, for many years president Walker & Pratt Mfg. Co., Watertown, Mass., died at his home in Malden, Mass., Jan. 4. Born in Boston, May 6, 1861, Mr. Walker was educated at Chauncy Hall school and the Massachusetts Institute of Technology from which he was graduated in 1882. He was the first editor of *Tech* the institute publication. Upon graduation he joined the company of which his father was president. He occupied various positions of responsibility and was elected president, in 1901, a position which he retained up to the time of his death. Mr. Walker was interested actively in many social, business and fraternal associations in Malden. He was formerly vice president of the First National Bank of Malden, trustee of the Malden Savings Bank, member of the Malden School committee and chairman in 1913. He was formerly president of the Malden Hospital and president of the Malden Y.M.C.A.

Mr. Walker was one of the organizers of the American Foundrymen's association. He served as New England district vice president in 1899 and as president of the association in 1902. He also served as president of the New England Stove association.

♦ ♦ ♦

James S. Shinkle, foundry foreman, Black-Clawson Co., Hamilton, O., died recently after a long illness.

♦ ♦ ♦

Edwin Joseph Skillman, 59, president, Spencer Turbine Co., Hartford, Conn., died Dec. 2 at the home of a friend.

♦ ♦ ♦

Herbert G. Foot, pattern maker, Westinghouse Air Brake Co. at Wilmerding and asociated with that company for many years, died recently at his home in Swissvale, Pa.

♦ ♦ ♦

James H. Coleman, 63, for 20 years in charge of the Cleveland district for the Tabor Mfg. Co., died recently after a short illness. Mr. Coleman was born in West Eaton, N. Y. and went to Cleveland 21 years ago.

♦ ♦ ♦

William W. Miller, 55, manager, industrial department of the General Electric Co., Schenectady, N. Y., died Dec. 22 in that city following an operation. Born in Rochester, N. Y., Mr. Miller moved to Schenectady with his parents and when 12 years old started work for General Electric, as an office boy. He graduated from the Union Classical institute in 1897 and in 1899 returned to General Electric where he entered the student engineering course. In 1920 he was made an assistant manager of the industrial department and in 1929 became manager, which position he held at the time of his death.

♦ ♦ ♦

Joel O. Cheek, 83, vice president, Farrell Cheek Steel Foundry Co., Sandusky, O., died in Jacksonville, Fla. recently. Born in Nashville, Tenn., he was a founder of the Cheek Neal Coffee Co., in that city. He was also the originator of the Maxwell House Showboat radio program. He was a summer visitor to Sandusky and became interested in the steel foundry business there.

A. W. Walker

♦ ♦ ♦

E. W. Whittemore, 59, former secretary and treasurer, National Malleable & Steel Castings Co., Cleveland, died Dec. 25 at his home in Cleveland after a year's illness. Mr. Whittemore became associated with National Malleable in 1898 after he graduated from Yale university. In the intervening years he rose to the position he occupied at the time of his retirement a year ago.

♦ ♦ ♦

William MacGregor, general sales manager, Carborundum Co., Niagara Falls, N. Y., died after a prolonged illness, in New York, on Dec. 18. He was born in Kemney, Aberdeenshire, Scotland, on Oct. 5, 1888, and after attending school in Aberdeen, joined his uncle, William MacGregor, in the manufacturing and manufacturers' agency business at Airdrie. In 1912 he came to the United States to join the staff of the Carborundum Co., and for several years traveled extensively as a sales representative. In 1918 Mr. MacGregor was appointed general sales representative of the coated abrasive paper and cloth division of the Carborundum Co., and later became sales manager of the stone and marble, and the coated abrasive paper and cloth divisions. In 1926 he was appointed general sales manager of the Carborundum company.

New England Group Studies Molding Methods

Edward N. Brough, foundry superintendent, Fairbanks Scale Co., St. Johnsbury, Vt., was the principal speaker at the regular meeting of the New England Foundrymen's association held at the Engineers club, Boston, Dec. 11, with George W. Thornburg, president of the association, presiding.

Mr. Brough spoke on the production of castings with the sandslinger. He explained in detail various castings produced with that type of equipment, and stated that his company uses both a portable and stationary machine. The speaker also told how molders are taught to use the machine. He explained that the work is on a piece basis of good castings produced, and that the loss due to defectives in his plant is less than 5 per cent. Photographs showing the machine in operation also were displayed. Considerable discussion followed the formal presentation.

A nominating committee consisting of three past presidents was appointed to nominate officers for balloting at the annual meeting in January.

Stresses Need for Apprenticeship Training

Franklin R. Hoadley, vice president, Farrel-Birmingham Co., Ansonia, Conn., spoke on "Apprenticeship Training" at a meeting of the New Jersey Foundrymen's association, held Dec. 18 at the Downtown club, Newark, N. J. Mr. Hoadley explained the urgent need for training new molders and described a highly successful plan of apprentice training in operation at his plant. W. H. Mantz, general manager, Atlas Foundry Co., Irvington, N. J. also described the apprentice program employed at the Atlas Co.

The association has appointed an apprentice committee with H. L. Edinger, Barnett Foundry & Machine Co., Irvington, N. J., as chairman, to promote training in the New Jersey district.

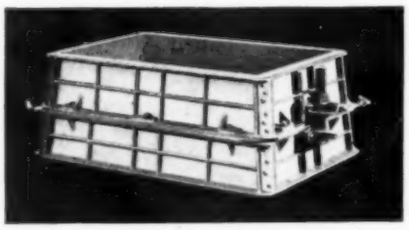
Parker Appliance Co., Cleveland, has moved its plant to larger quarters at 17325 Euclid avenue.

ADVERTISING PAGES REMOVED

NEW EQUIPMENT . . . . *for foundries*

Taper Flask Made of Magnesium Alloy

American Foundry Equipment Co., 555 Byrkit street, Mishawaka, Ind., has introduced a featherweight flask made of a magnesium alloy. Features claimed for the flask include Light weight, strengthened corner construction, specially designed pin pad, and the production increasing sand strip.



A specially designed pin pad permits use of any standard pin

The new corner design is of riveted construction. A specially designed pin pad permits the use of any standard pin. Pins which are now standard can be supplied on the new flask. Molding machines, matchplates, etc. do not have to be altered for a special pin.

With a maximum taper of 5 degrees, the flask permits easy stripping. The sand strip, which is of special design, protrudes an equal distance completely around the flask, providing a firm support for the sand in the cope. The sand strip is cadmium plated, eliminating rust.

Permits Throttling Of Control Instrument

Foxboro Co., Foxboro, Mass., has introduced a new accessory for air-operated control valves, developed to eliminate valve sticking and to assure hair-line valve positioning. The device enables throttling air-operated control instruments to make small gradual adjustments of the control valve position regardless of friction or hysteresis. It is claimed that the air from the control instrument need change as little as ½-inch of water to cause a corrective positioning of the valve and force the stem to take a position within 1/1000th inch of the previous one.

The unit is mounted in a cast aluminum case, is completely weatherproof and may be exposed to the elements.

Respirator Designed To Protect Against Lead

Willson Products Inc., Reading, Pa., has introduced a new type respirator designed especially to protect against lead and Type A dusts.

The filter bag has an area of 40 square inches so that the operator may breathe close to normal. The face mask is made of rubber and is adjustable to any shape of face by bending the wire forming spring which constitutes a part of the lower mask edge.

The filter bag is assembled on the mask with a screw ring which has an intake valve assembly inside, including moisture baffle, serrations to prevent air lock and a flexible intake diaphragm.

Air is drawn in through the filter bag at the front and exhausted through the valve assembly below the face mask. These respirators weigh 5 ¼-ounces.

The filter bag has an area of 40 square inches

Pneumatic Grinders Are Built in Three Sizes

Cleveland Pneumatic Tool Co., 3734 East Seventy-eighth street, Cleveland, has introduced a line of pneumatic hand grinders providing extra power for the size and weight. The grinder is developed around a rotary motor which uses a 4-blade rotor, concentric with the arbor and is supplied with renewable cylinder bushings.

Either spade or straight handle can be supplied

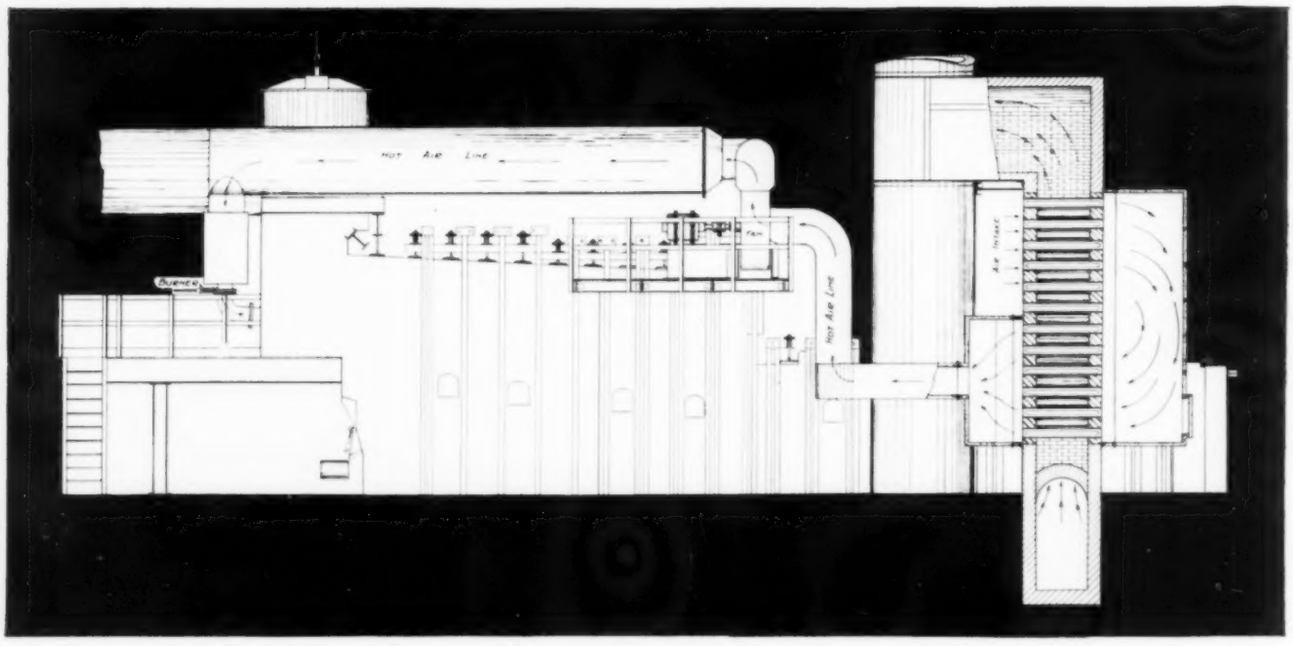
The rotor is of one piece construction and is heat treated and ground to size within close limits. The construction permits the use of wide blades, thereby, it is claimed, giving longer blade life and promoting efficient and economical motor action. Air is admitted under each blade throughout the entire sector to insure immediate starting even under loads. A double row of ball bearings at the wheel end is designed to take the end thrust in both directions. One roller bearing is anchored so as to eliminate end-play and prevent the rotor from rubbing the end plates.

Oil from a reservoir supplies lubrication for the rotor, its blades, and the throttle mechanism. Two oil filler holes take care of all bearings and the governor.

These grinders are built in three sizes and speeds namely, 3000, 3400 and 5800 revolutions per minute. Either a straight handle or a spade handle can be supplied. Standard arbor is ⅝-inch diameter for 1¼-inch wheel, but arbor for 1½-inch width of wheel can be supplied.

A proposed federal specification covering cast iron drainage, vent and waste pipe recently has been prepared. When adopted, this specification will govern the purchase of such pipe by the government.

It is very easy to apply this Recuperator to present furnaces



A CASE in point is the recuperator layout for a producer gas fired, continuous billet heating furnace, as illustrated. Existing flues and stack are used. There is a decided saving in fuel, and of course money, in this installation. There are no changes in the furnace proper.

Add accessibility, ease and convenience in repairs, high efficiency, and durability and it is then easy to see why more and more operators of various types of furnaces have installed The Carborundum Company's recuperator.

Savings of 25% to 35% in fuel costs are not unusual, due to recuperation. The "Carbofrax" Tubes assure efficient heat recovery. They can withstand the severest of temperature conditions.

Let us study your furnace conditions and show you how your operating costs can be reduced.

THE CARBORUNDUM COMPANY'S
REG. U. S. PAT. OFF.

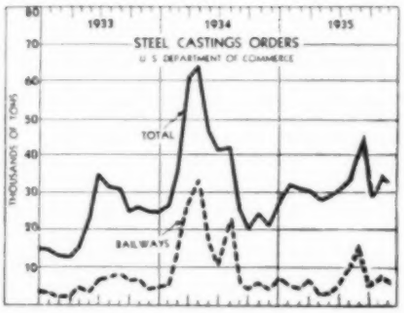
RECUPERATOR

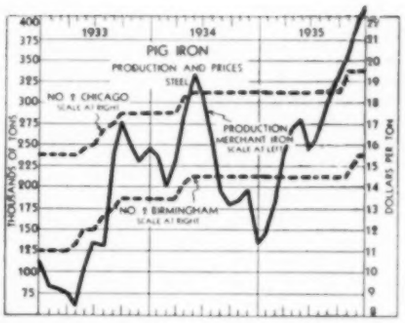
Equipped with "Carbofrax" Tubes
REG. U. S. PAT. OFF.

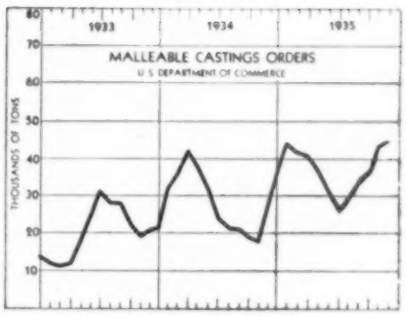
TUNE IN THE CARBORUNDUM BAND
Saturdays at 7:30 P.M., E.S.T.
Columbia Chain

A Product of **THE REFRACTORY DIVISION,** *Perth Amboy, N. J.*

District Sales Branches: Boston, Chicago, Cleveland, Detroit, Philadelphia, Pittsburgh. Agents: L. F. McConnell, Birmingham, Ala.; Christy Firebrick Company; St. Louis; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Co., Los Angeles, San Francisco, Seattle; Denver Fireclay Co., El Paso, Texas, Williams and Wilson, Ltd., Montreal, Toronto, Canada. (Carborundum and Carbofrax are registered trade-marks of The Carborundum Company.)







Foundry Activities

Reflect Industrial Trends

UNITED STATES PIPE & Foundry Co., Chattanooga, Tenn., has awarded the contract for construction of its plant to the United Engineers & Constructors Inc., of Philadelphia. Construction work on new buildings and remodeling will begin shortly, according to Edward Hering, chief engineer, at an estimated cost of $700,000. Besides improvements to old buildings, a series of new structures will be built at the Twenty-sixth street plant site. Among the new buildings will be an extension to the foundry building 125 feet in length including a 219 foot crane runway for storage of pipe tool equipment; a two story pattern storage building; a new machine shop equipped with a large traveling crane; smith shop; carpenter shop; commissary; cleaning and coating and testing department building, and two raw material storage buildings.

* * *

Guenther Foundry Co., Columbus, O., has been incorporated by John C. Guenther, Robert G. Walters and Elsa Dorathea.

* * *

Pontiac Motor Co. foundry, Pontiac, Mich. is now in operation and will increase production gradually during the coming months.

* * *

William Cobb Foundry Co., West Clinton street, Jackson, Mich., has made plans for a new foundry building to cost approximately $12,000 excluding equipment.

* * *

Albra Castings Corp., Huntington, Ind., has been incorporated as a preliminary step to taking over the property and business of the Rinebolt Foundry Co. of that city. The company will produce nonferrous castings. Incorporators are Herman Voges Jr., president; V. W. Pacula, vice president and plant superintendent; S. W. Richey, secretary; Charles L. Terrell, treasurer; and B. W. Voges, director.

* * *

Quincy Stove Mfg. Co., Quincy, Ill. has purchased the plant of the J. R. Little Metal Wheel Works on North Bottom road, according to a recent announcement. The need for larger foundry and warehouse space prompted this move. The company plans to retain its plant and headquarters at 807 South Front street and will not acquire the business of the J. R. Little Metal Wheel Works. The recently purchased plant consists of three structures, one three stories high and the other two of one story each. The foundry building, which is 120 x 400 feet, can accommodate 200 molders.

* * *

Gilpen Foundry Co. Inc., 1250 East Gilbert street, Muncie, Ind., has been incorporated by Merelen J. Gilpen, Virginia M. Gilpen and Harry C. Rowe to engage in general foundry and machine shop business.

* * *

Bremer Aluminum Corp., New Washington, O., recently has been organized to manufacture aluminum products. W. S. Bremer, A. L. Lea and V. S. Heydinger are the organizers.

* * *

Lakey Foundry & Machine Co., Muskegon, Mich. recently increased its force to more than 1000 men and has prospects of greatly improved business through large contracts for coming months.

* * *

Reading Vitreous Enameling & Foundry Co., Reading, Pa., has been incorporated to make metal and enamel products by Sarah G. Blatt, Samuel F. Blatt and Leonard E. Bilger.

* * *

Dedman Foundry & Machine Co., Houston, Texas, has recently completed the building of a new foundry at the foot of Buffalo street. The foundry is equipped with modern machinery and the company has the facilities to produce iron castings up to 10 tons and steel castings up to

RAW MATERIAL PRICES
Dec. 9, 1935

Iron	
No. 2 foundry, Valley	$19.50
No. 2 Southern, Birmingham	15.50
No. 2 foundry, Chicago	19.50
No. 2 foundry, Buffalo	19.50
Basic, Buffalo	18.50
Basic, Valley	19.00
Malleable, Chicago	19.50
Malleable, Buffalo	20.00
Charcoal iron, furnace	22.00
Coke	
Connellsville beehive premium	$5.50 to $5.75
Wise county beehive coke	4.30 to 5.00
Detroit by-product coke	9.00
Scrap	
Heavy melting steel, Valley	$13.50 to $14.00
Heavy melting steel, Pitts.(dlv)	14.25 to 14.75
Heavy melting steel, Chicago	13.00 to 13.50
Stove plate, Buffalo	10.25 to 10.75
Stove plate, Chicago	7.00 to 7.50
No. 1 cast, New York	9.50 to 10.00
No. 1 cast, mchy., Chicago	12.00 to 12.50
No. 1 cast, Pittsburgh	13.75 to 14.25
No. 1 cast, Philadelphia	12.50 to 13.00
No. 1 cast, Birmingham	8.50 to 9.00
Car wheels, iron, Pittsburgh	14.00 to 14.50
Car wheels, iron, Chicago	13.00 to 13.50
Railroad malleable, Chicago	15.75 to 16.25
Malleable, Buffalo	15.00 to 15.50
Nonferrous Metals	**Cents per pound**
Castings copper, refinery	8.85 to 8.95
Straits tin	47.12½
Aluminum, 99 per cent	19.00 to 21.00
Aluminum, No. 12 (Secondary, standard)	17.00 to 17.50
Lead, New York	4.50
Antimony, New York	13.75
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.85

2½ tons. The new foundry represents an investment of more than $75,000 and is one of the largest projects undertaken in the Southwest. H. W. Dedman is president and general manager, and C. E. Newton, assistant manager and secretary.

* * *

Decatur Model Brass Co., Decatur, Ill., was issued a state charter according to a recent report. Clifford B. McKelvey is president of the company, with Harley O. Potter as vice president and Ted Fleming, secretary and treasurer.

* * *

Arrangements are being made to move the plant of the Dunham Co., Berea, O., manufacturer of farm machinery, to Elyria, O. The company is planning to occupy the building formerly used by the Willys Overland Co.

* * *

Construction of an addition, 70 x 70 feet, to the plant of the Titus Foundry Co., Coldwater, Mich., has been completed and operation already started according to officials of the company. The new building is equipped with roller conveyors, spray booths and crating department.

* * *

General Malleable Corp., Spring City Foundry Co., Werra Aluminum Co., Quality Aluminum and Waukesha Foundry Co., all of Waukesha, Wis., report a steady increase in business over last year with a bright outlook for the immediate months ahead.

* * *

C. & G. Foundry & Pattern Works, Indianapolis, recently celebrated its sixteenth anniversary. The firm was established in 1919 by Charles J. Gisler. Officials of the company report that their business for the first three-quarters of last year practically doubled that of the corresponding period of 1934.

* * *

Iroquois Foundry Co., Racine, Wis., recently purchased the plant formerly occupied by the Simplex Furnace Corp. The building is being remodeled and equipped with modern foundry equipment. Although general jobbing work is being done now, it is expected that production will branch into light gray iron work. R. L. Neiss is president and August Vierthaler is vice president.

* * *

Index of foundry equipment orders for November, according to a report of the Foundry Equipment Manufacturers' association, Cleveland, was 99.8 as compared with 140.0 for October and 80.4 for November of the previous year. Index of shipments was 145.2 for November as compared with 119.7 in October and 59.6 in November, 1934.

* * *

Central Pattern & Foundry Co., Chicago, recently observed its tenth anniversary and completion of an addition to its plant. The addition, made to the office and foundry, involved an expenditure of $40,000 in addition to $10,000 for equipment. The company manufactures aluminum and bronze castings.

* * *

Remodeling of the Malleable Iron Co. plant, Zanesville, O., under a project of the Works Progress administration has been assured through formal announcement of a government grant for that purpose. When complete, the plant will be turned over to the Rubin Bros., Footwear, Inc. as a second unit in this local manufacturing enterprise.

* * *

Total foundry activity in the Philadelphia federal reserve district declined during November according to reports of the industrial research department, University of Pennsylvania. Because of unusual activity in a few gray iron plants, total products of gray iron castings was slightly higher. A comparison extending back to 1926 shows that this is the first time that gray iron foundries have been able to continue during November an increased rate of activity established in October. The real improvement of conditions can best be judged by comparing the activity of November 1935 with that of November of last year. Total production of gray iron castings this November was nearly 30 per cent larger than that of last year and production of castings for jobbing work was more than 40 per cent larger.

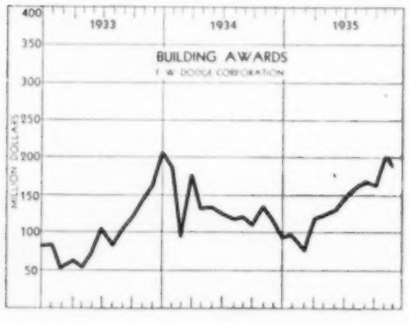
NEW Trade Publications

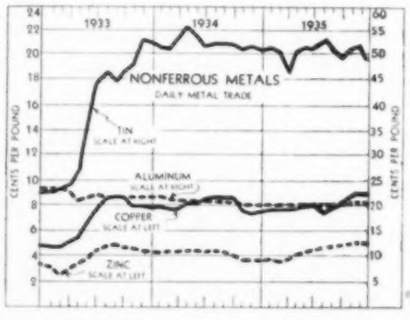
FLEXIBLE SHAFT EQUIPMENT—R. G. Haskins Co., 4636 West Fulton street, Chicago, has published a new general catalog No. 44 covering its line of flexible shaft equipment. In addition to complete specifications for machines, the booklet treats many applications of that type of equipment in various industries. The publication presents a great number of illustrations.

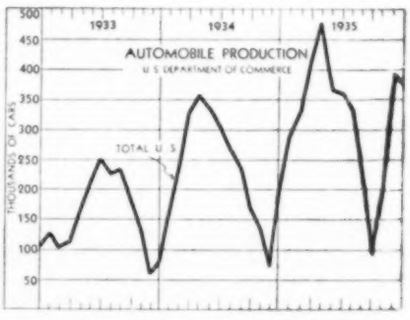
PLATING—Automatic and semi-automatic plating equipment manufactured by Frederick B. Stevens Inc., Detroit, is described in detail in a 20-page catalog just published. Numerous illustrations and blueprints are presented, and the machines described are its Model A, automatic; Model B, automatic; Model C, automatic, small parts; straight-line, automatic; auto-plater, and several semi-automatic machines.

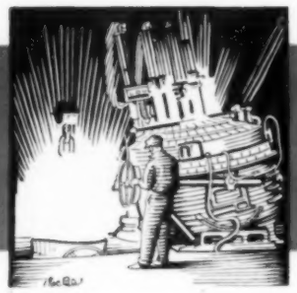
ARC WELDERS—Hobart Bros. Co., Troy, O., has published a booklet providing a pictorial trip through its plant devoted to the manufacture of arc welding equipment. Several types of machines also are illustrated.

SILICA FIRESTONE — Cleveland Quarries Co., Cleveland, has published bulletin No. 15 devoted to Buckeye silica firestone for refractory use including cupola linings. Other recent publications of that company are devoted to silica firestone for acid tanks; for steel pickling tanks and acid wash trays; silica firstone for steel mill use and the advantages of silica firestone as a cupola lining.









The Foundry

for February

Jobbing Shops Need Action

THE dictionary defines a foundry as "the place where metal casting is carried on." All foundries make up the industry. THE FOUNDRY editors undertake to present and interpret fact or opinion which in any way advances the well-being of the foundry industry.

Our efforts are based on no assumption of superior knowledge or infallibility. It seems to be the legitimate function of the paper to deal with complete sincerity in any or all aspects of the foundry business which are of sufficient importance to deserve consideration by our widespread readers. All facts, data, articles and editorials are presented in a spirit of helpfulness.

Last month, editorial "Yours Received and in Reply," aroused conflicting emotions in the minds of readers and has brought comment both approving and condemning.

There are more than five thousand foundries said to be operating in this country. During recent years we have had the privilege of describing relatively few new foundry enterprises and those have been practically all shops built by the users of castings—foundry departments rather than jobbing foundries.

Each foundry so built takes tonnage formerly made by independent plants. The loss of these tonnages aggravates the problem for all.

The loss of one customer and his patterns invariably means that the loser starts out on a hunt for other customers and this is usually with only one weapon—*price*.

We believe that independent foundries represent an integral part of the manufacturing interest of this country. We hold that such foundries to exist must be operated at a profit and are convinced that the profit must be made in three years of good business to cover five year periods.

It is notorious that there has been no profit in the business for anyone during the depression and little profit at any time since the war. Admittedly, some have made money, but out of the total of five thousand, they are mighty few.

In studying this unprofitable condition and on finding that substantially the only new foundries are either already large concerns or are departmental foundries, we necessarily come upon the fact that the independent foundries must do *many* things differently.

Only a part of what must be done differently was mentioned in the editorial last month. No useful purpose can be served by coddling, pampering, slighting or even tolerating conditions which adversely affect the profit of the industry. Perhaps it needs a swift kick now and then. We do ourselves, and received several because of the January editorial. The facts remain and the question is, What will the jobbing foundrymen do about it?

He Was a Casting Man

RECENTLY a steel company executive made the following statement: "The vice president and general manager of the company had no real conception of what advertising was all about, because he was a casting man and I trust you know what I mean by that!"

As readers of THE FOUNDRY know, we have a deep interest in the well being of the foundry industry. We pan foundrymen ourselves, in the hope of stimulating them to greater and more successful activity. But we don't like aspersions by outsiders.

Naturally manufacturers of castings will not try to sell to each other. Therefore, they are not expected to advertise lavishly in *this* paper. But many have found that they can advertise successfully and sell castings through other business papers.

While holding no brief for trade or business paper advertising outside the covers of THE FOUNDRY, we ask our foundry readers whether they *are* the world's worst advertisers.

Editor

FIFTIETH ANNIVERSARY MARKS PROGRESS IN CASTING ALUMINUM

By H. J. ROWE

Fig. 1—Riddled sand being thrown between the chills on the drag surface of the pattern

THIS month marks the fiftieth anniversary of Charles Martin Hall's discovery of the electrolytic process for the manufacture of aluminum. Before this discovery in 1886, the aluminum casting art was limited to the production of novelties and jewelry, with castings weighing from a fraction of an ounce to probably several ounces. Although aluminum had been known by scientists since 1825, its cost as well as the supply limited its use. This early production did not present many foundry problems, since in most cases the casting was done by goldsmiths and silversmiths, using the same methods as they used for gold and silver.

Today, aluminum castings have a well defined place in engineering fields. Castings weighing 500 pounds are common foundry products, while castings weighing more than 7000 pounds are produced. The production of such castings has resulted in problems peculiar to aluminum, solving of which has supplied an important contribution to general knowledge of foundrymen. It is significant that in a short span of 50 years the aluminum foundry art has been developed to a point comparable with the iron and copper alloy casting arts whose origins date centuries before.

It is unnecessary to comment in detail on the

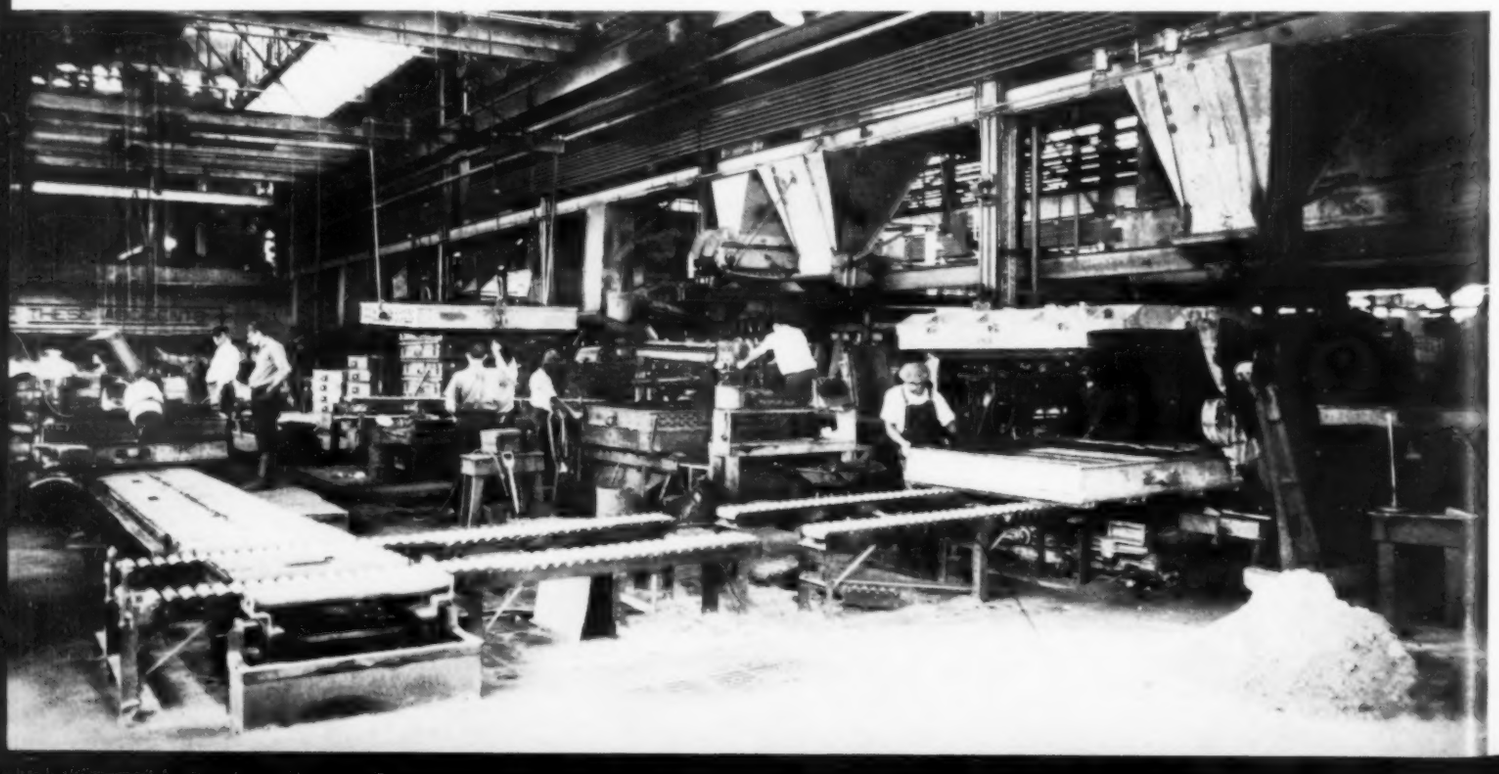
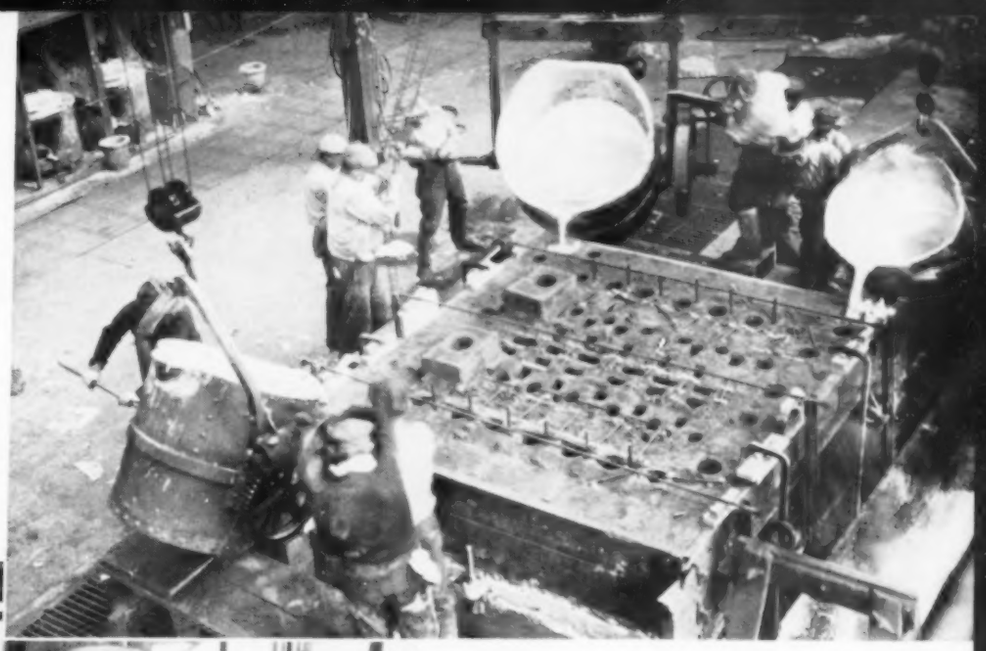


Fig. 2—Large molds frequently can be handled on a conveyor system



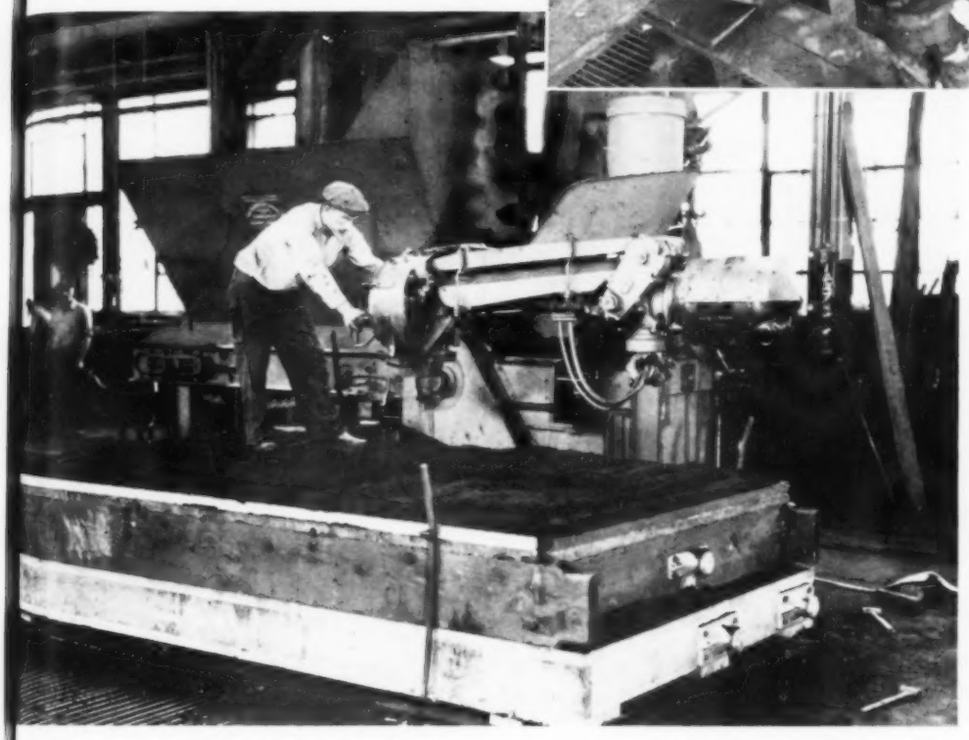


Fig. 3 (Right)—A large aluminum alloy casting being poured in a mold entirely above the floor level. Fig. 4 (Below)—Ramming a large drag with the aid of a sand-slinger

progress of aluminum foundry practice to its present state, except to point out that well directed and concentrated research has had an important part in what has been accomplished. Pure aluminum possesses neither mechanical properties nor casting characteristics for satisfactory general use. The development of alloys with suitable foundry characteristics therefore has been of major importance. At present, a considerable number of casting alloys are available for commercial use, with properties suitable for many applications. For some years after the common alloy developments, there was a development of heat-treated alloys to fulfill the demand for castings of greater strength and shock resistance. Today, aluminum casting alloys are available to meet almost all engineering requirements.

Aside from the mechanical properties of aluminum alloy castings, they possess certain physical characteristics which make them highly desirable. First among these is their light weight, since they are but two-fifths the weight of iron and one-third the weight of copper. This is well recognized in their application to aircraft, trucks and buses, diesel engines, portable tools, handling equipment and reciprocating parts. Excellent corrosion resistance is a second characteristic which accounts for the successful use of aluminum castings in marine construction, chemical and food processing equipment, and in buildings. A third physical characteristic, high thermal conductivity, is utilized for cast cooking utensiles, internal combustion engine cylinder heads, and heating appliances. Fourth, electrical conductivity and diamagnetic properties find recognition in electrical fittings, welding machinery and motor housings. These, which are just a few of the present applications, indicate the variety of castings.

In external appearances, the modern aluminum foundry differs little from foundries making gray iron, brass, or bronze castings. All employ similar methods for handling and conditioning sand, core making and molding. In some foundries, even the melting equipment used for copper base alloys can be used for melting aluminum alloys. Like other ferrous and nonferrous alloys, aluminum alloys possess certain inherent properties which cause those less obvious differences in the foundry problems, such as sand control, metal handling, temperature control and gating practice.

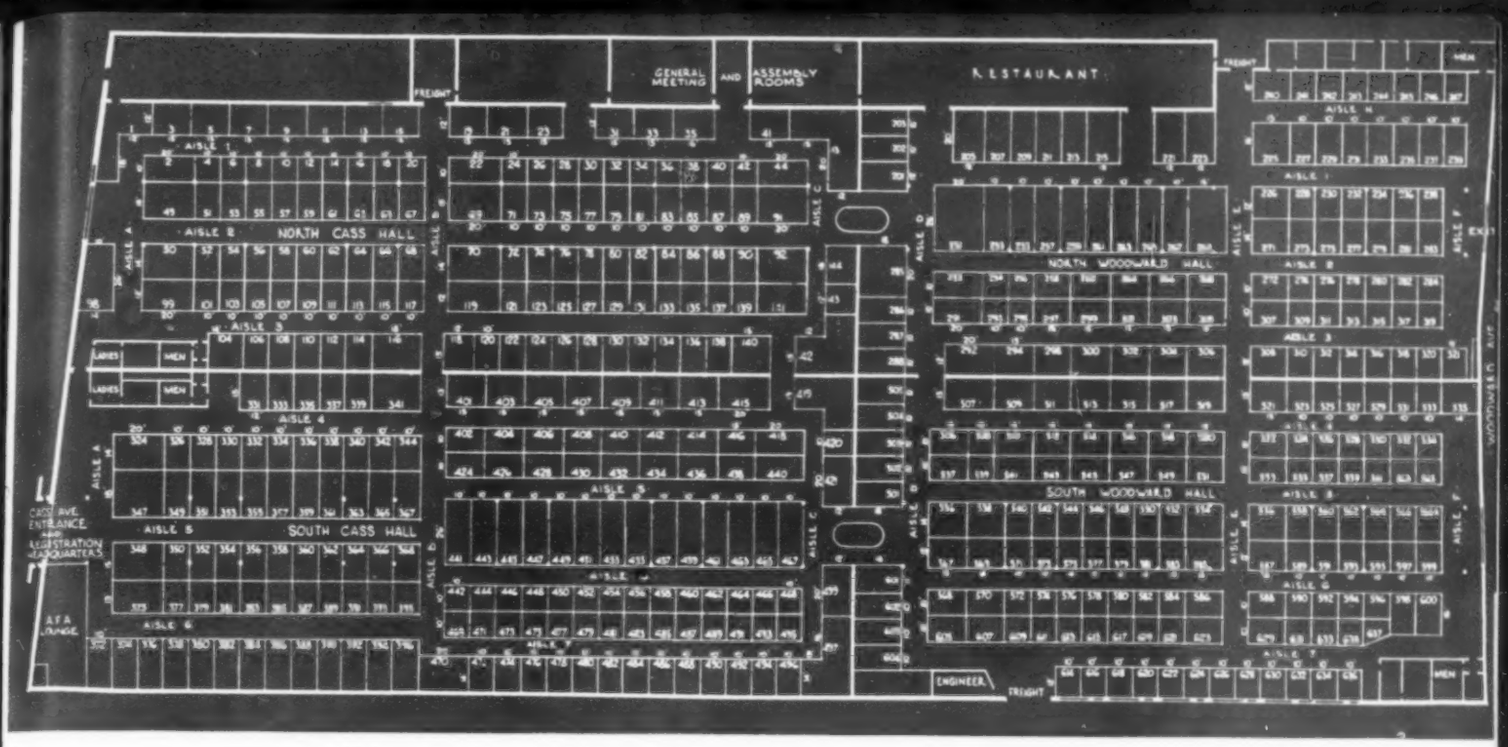
Fig. 3 (Above) — Several types of castings showing gates. Fig. 5 (Left)—Charles Martin Hall

There are three important characteristics of aluminum alloys which materially influence the foundry practice. The first is their light weight or low specific gravity. This is of considerable advantage since it reduces mold pressures and permits lighter sand ramming and mold equipment. It, however, has the disadvantage of making it harder for aluminum alloys to rid themselves of oxide inclusions and drive off mold gases than the heavier metals. The molder of castings, if they incorporate thin ribs and fins, must provide for this characteristic by adequate venting and means for removing any oxide formed. The molding of thin ribs and fins in the drag is a preferable practice.

A second characteristic of aluminum alloys is their "hot shortness," or weakness at temperatures just below that at which the metal solidifies. Any resistance to normal contraction while a casting passes through this state may result in cracks. By watching such factors as sand ramming, core strength, and other mold conditions which may resist the contraction of a sand casting, the effects of this hot short condition can be avoided. Certain alloys are less hot short than others; the aluminum silicon alloys are much less susceptible to cracking than the aluminum copper alloys. The selection of an alloy for a particular casting should include a consideration of this factor.

The third, and perhaps the most important characteristic of aluminum alloys, is their high crystallization shrinkage, or change in volume from the liquid to the solid state. Failure to recognize this characteristic results in defects such as draws or shrinks, porosity and internal unsoundness. The gating of aluminum castings therefore must include a generous use of risers placed so as to feed progressively the solidifying casting. The judicious use of chills on the heavier sections to produce more uniform solidification, is advisable in controlling the high crystallization shrinkage. (*Please turn to page* 63)

Fig. 7—Metal is removed from the surface and the temperature checked immediately before pouring



DETROIT ANTICIPATES RECORD SHOW

WHEN the American Foundrymen's association calls to order the first technical session of its Fortieth annual convention, and throws open the doors of the Foundry and Allied Industries Exposition in Detroit in just a little over two months, the foundry industry of America will find assembled in the Motor City the largest gathering of its industrial leaders in over six years and the greatest exhibition of foundry equipment, supplies and allied equipment since Detroit in 1926, Philadelphia in 1928 and Cleveland in 1930.

Many Foundrymen Expect to Attend

Contact with various foundry centers throughout the country provides the basis for such predictions. Presidents, general managers, superintendents, metallurgists, and foremen in every section throughout the East, South and Middle West in great numbers daily are indicating their intention of being present in Detroit from May 4 to 9 to have a part in the review of technical and mechanical progress of the industry, and to discover through the interchange of information on modern practices and the drama of the exposition the future course of the foundry industry as it moves forward in the vanguard of industrial recovery.

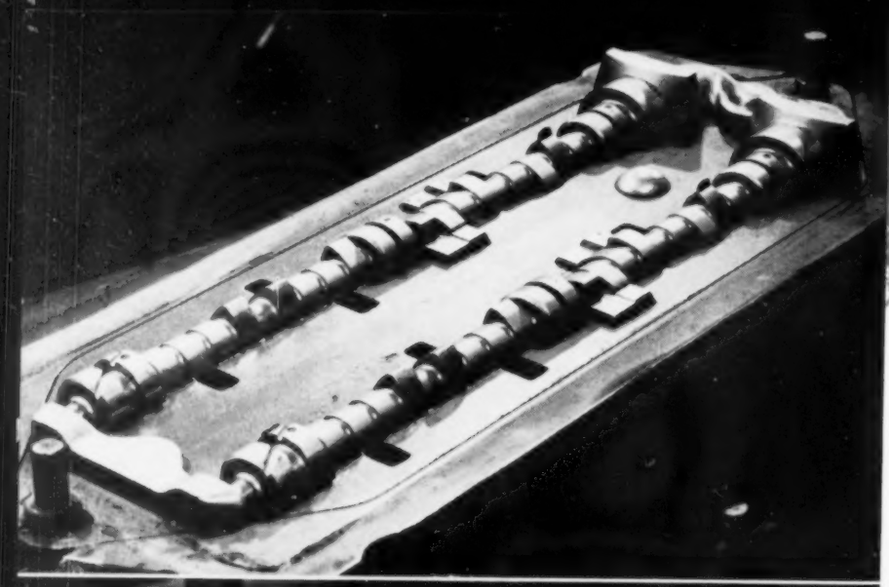
Manufacturers of equipment and supplies have been quick to sense the great size and scope of the coming convention and exhibition to be staged under the auspices of the A. F. A., with the result that reservations for space following the first announcement by Executive Secretary C. E. Hoyt, have far exceeded those made during the similar period for any exhibition during the last ten years. The release of exposition floor plans, as reproduced at the top of this page, has accelerated reservations impressively.

Selection of Detroit for the Fortieth anniversary convention provides an excellent convention hall within easy access of the city's many splendid hotels in the downtown section and the fine residential hotels nearby. The exhibition building, constructed since the Detroit International Congress in 1926, is divided into four large halls that permit segregation of operating and nonoperating exhibits. Ample facilities are provided in the convention hall for many of the technical sessions which will be held there.

Extensive Plant Visitations Planned

Detroit also excels in the exemplification of modern foundry practice. Announcement has been made that the Detroit committee on plant visitation, organized by the Detroit Chapter of the A. F. A., will arrange for organized plant inspection on Monday, May 4. According to present plans, Tuesday, Wednesday, Thursday and Friday will be reserved for meetings and the exhibition. Saturday will be devoted exclusively to exhibit inspection and will feature Detroit district attendance.

Plans for the technical sessions rapidly are being completed and Robert E. Kennedy, technical secretary, expects to have a tentative program ready for presentation in the March issue of THE FOUNDRY.



Figs. 1 and 2—Drag and cope patterns for camshafts showing the sprue, runner, gate and shrinkbobs at the left and the additional feeder at the right

Ford Casts Parts Of Alloy Iron and Steel

KNOWN by reputation to millions of readers a fortunate young lad named Aladdin rose to dizzy heights of power and glory through the possession of a finger ring and a small brass lamp. To gratify any wish, all he had to do was to rub either the ring or the lamp lightly and nonchalantly, presumably after the manner of a modern flapper buffing the digital extremities, and lo and behold a geni stood by his side ready and willing to deliver the goods. Unfortunately, up to the present, and notwithstanding the earnest effort of archeologists and other delvers into the past, no tangible evidence ever has been discovered to substantiate Aladdin's claim to a place in the hall of fame. Despite this lack of proof, the Aladdin legend, like John Brown's body, goes bravely marching on.

The more or less mythical Aladdin was quite a lad in his day, but during the past 30 years the exploits of a modern Aladdin have dimmed to a considerable extent the luster attaching to the memory of the famous hero of the *Arabian Nights*. The modern genii of the ring and lamp have had little time out since Henry Ford administered the first tentative rub to the magical devices. In the intervening years up to the present the lamp has been rubbed diligently with far reaching results in mechanical, metallurgical, financial and economic fields. Further improvement and extension in plant, equipment and methods of the Ford Motor Co. always are in progress or in contemplation. The latest expansion program at the River Rouge plant, Detroit, involving the expenditure of $20,000,000 includes the following major items:

1—36-inch water line from power house tunnel to new rolling mill. 2—Hot strip mill 150 x 1000 feet completely equipped to cost $6,000,000. 3—New blooming mill. 4—Cold finishing mill to cost $3,500,000 with equipment. No. 5—Ingot stripper. 6—Reconstruction of blast furnace *A* to increase capacity from 600 to 800 tons per day. 7—Modernization of main power house at a cost of $4,600,000. 8—Alloy steel casting department in foundry. Cost including other foundry changes $675,000.

Melting and molding equipment in the north end of the foundry formerly devoted to the production of nonferrous castings has been removed and replaced by more extensive equipment for the production of brake drums, clutch pedals and other parts in alloy steels melted in three 4-ton electric furnaces. The molding equipment includes six sandslinger units with turntables, roll-over machines and conveyors.

In another part of the foundry production of cylinder blocks has been accelerated by the installation of an air furnace and rearrangement of the melting and pouring equipment. Under the new setup it no longer is necessary to carry metal in ladles from the furnace to the molds. A constant supply is available at the pouring sta-

tion and the molds are filled in rapid succession. The reservoir furnace serves two conveyor units simultaneously to the extent of 400 to 450 molds per hour, 3200 to 3600 per 8-hour day, between 6000 and 7000 on the usual double shift or 16-hour day, and approximately 10,000 on a triple shift or 24-hour day basis.

Although alloy steels of various compositions have been developed successfully for the production of many parts of the automobile engine, cast iron still is found most satisfactory for the cylinder block. Composition of this iron shows: Total carbon 3.20-3.40 per cent, silicon 1.90-2.10 per cent, sulphur 0.10 per cent maximum, phosphorus 0.25-0.32 per cent, manganese 0.60-0.80 per cent, copper, 0.75 per cent.

Mixture of Blast Furnace and Cupola Metal

Iron for the cylinder blocks is a mixture of direct metal from the blast furnace and metal melted in the cupola. With the analysis of both metals known, a sufficient quantity of each, usually 60 per cent direct metal and 40 per cent cupola metal, is poured into a 400-ton mixer where the metal assumes the composition required in the castings. At this stage the temperature of the metal is not high enough for pouring into thin wall castings. To secure the desired temperature the metal is transferred by ladle from the mixer to a 15-ton electric furnace where it is superheated to a temperature of approximately 2900 degrees Fahr. Formerly this superheated metal was poured into small ladles suspended from a monorail and transferred to the molds as they moved along.

Under the latest arrangement the metal leaves the electric furnace and flows through a long spout into an air furnace located close to the ends of two adjacent conveyor units. The air furnace is fired with powdered coal and has a normal holding capacity of 35 tons of molten metal. To a certain extent this furnace may be compared to the forehearth on a cupola since it simply is a chamber where the metal is collected from one side, discharged at the opposite side and maintained at a constant high temperature.

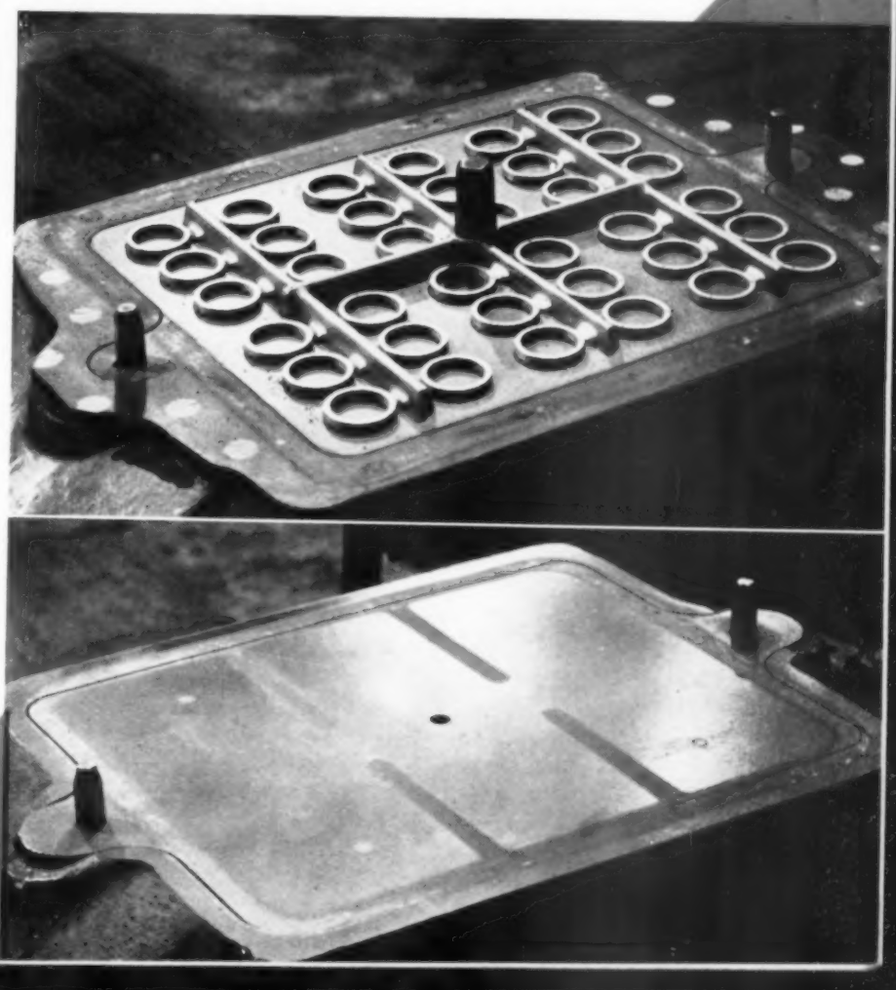
A batch of superheated metal from the electric furnace is discharged into this reservoir furnace every 15 minutes. On the opposite side of the furnace the metal flows in a steady stream through two spouts, one near each end. The spouts discharge the metal into two trough shaped ladles suspended from a short monorail over the end of each mold conveyor unit. Each of these ladles is provided with a pouring lip at the far end over which the metal is poured into each mold. The ladle is not fixed, but is free to travel a short distance to coincide with the movement of the mold.

Culmination of Long Series of Experiments

Introduction of this method represents the culmination of a long series of experiments designed to eliminate the gap between the furnace and the mold while maintaining the desired composition and temperature of the metal. Possibly an adaptation of this process eventually will be developed on other units in the foundry devoted to the production of crankshafts, camshafts, brake drums, and other component cast parts of the engine.

Faced with the problem of producing castings to meet hitherto undreamed physical, chemical and mechanical specifications, the automobile industry consistently since its inception has discarded tradition and boldly pioneered in mechanical, industrial and metallurgical fields. Initial expense has been subordinated to anticipated final results. This feature has characterized the operation of the Ford foundry to a marked extent. In addition to its function as a huge production shop, the foundry is an experimental laboratory constantly in a state of transition. Changes are made without letdown in daily production of over 2000 tons.

Cumulative experience over a period of many years has resulted in the development of special metals in the border-(*Please turn to page 70*)



Figs. 3 and 4—Drag and cope pattern plates for valve inset rings. The molds are stacked and poured three high

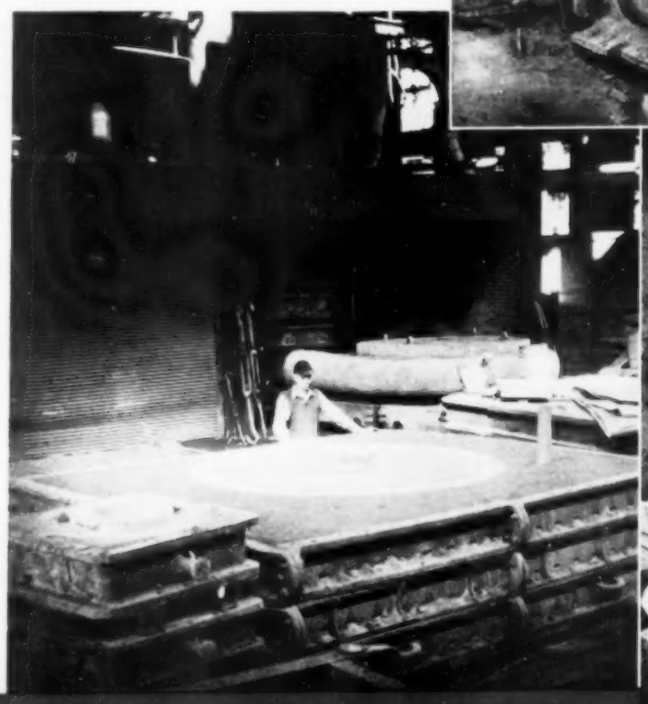
Pictures on these two pages represent various stages in the production of a dredge runner casting shown in Figs. 2 and 6. Fig. 1 (Left) — Base of the mold showing lower gate and seat for cores. Fig. 3 (Below) — The main core is a comparatively thin shell of cement bonded sand filled with cinders

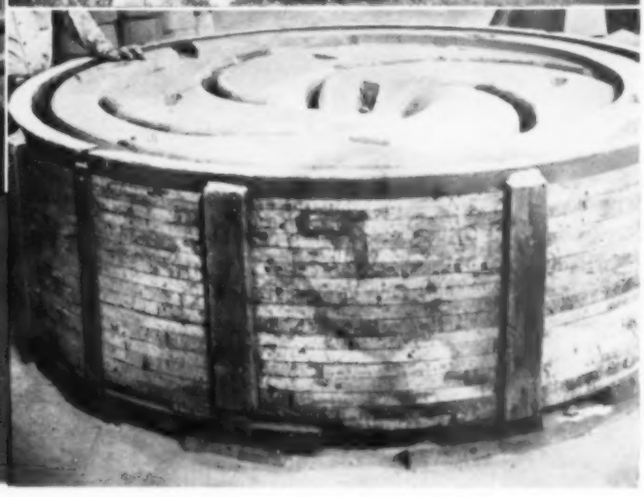
Steel Castings In Molds Bonded

SEVERAL interesting features in the application of the Randupson process as practiced in the plant of the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., are shown in the accompanying illustrations of successive steps in the production of a steel impeller casting for a dredge. The casting, 84 inches diameter, 22½ inches face and weight 5 tons, is made up of a top and bottom circular plate, four vanes and a hub. Some of the features conform to ordinary foundry practice, while others present marked points of difference.

Fig. 1 shows a drag partly filled with rubble, broken material from former molds retrieved from the cleaning room. A suitable thickness of cement bonded sand was rammed on top of this bed and then swept to the shape shown in the illustration to form the bottom face of the mold and a seat for the one piece core shown in Fig. 3. A tangential gate shown in the left background (Fig. 1) conducted the metal into the bottom circular plate, while a second similar gate as shown in Fig. 2 delivered metal to the top plate. The bottom gate is inclined toward the right while the top gate is inclined toward the left. A number of flat chills in the bottom face serve the double purpose of reinforcing the face where the speed of the inrushing metal is greatest, and also absorb a certain amount of heat, thus equalizing the temperature of the metal throughout this section of the casting. Whereas the former sand mold and core for this

Fig. 4 (Below)—The drag with core in place and with a wood covering on which to ram the cope. Fig. 5 (Right)—The complete mold clamped and with runner and risers made up ready for the metal. Fig. 7 (Below at right)—The core is rammed in the corebox in the position it will occupy in the mold





Are Produced With Cement

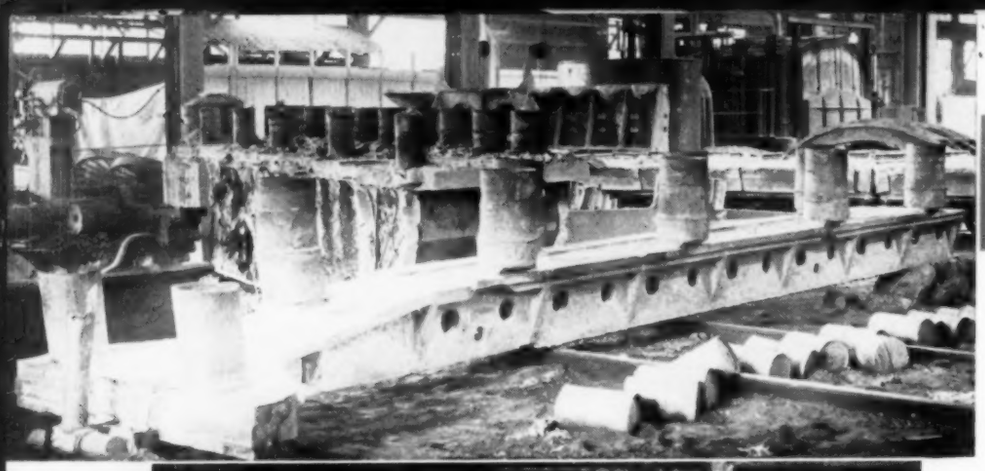
By PAT DWYER

casting were surface nailed all over, no nails are needed on the face of the mold and core composed of the sand bonded with cement. The surface of the casting shown in Fig. 6 is perfectly smooth and clean.

Part of the gate in the bottom is covered by the print of the main core. The space between this main core and the tile is covered by a flat slab. The gate on the top plate is cut in the core as shown slightly to the right of the man's left hand in Fig. 7.

The corebox shown in Fig. 7 may be adapted to several size cores. The ring may be increased or decreased in height and the diameter may be changed by placing loose lagging of varying thicknesses inside the permanent rim. Removal of these vertical lagging strips immediately after the core is rammed and before the material becomes hard, facilitates the removal of the core from the corebox. The vanes are adjusted in place by dowel pins in the bottom of the box and by temporary strips fastened across the top.

As with all molds and cores made from the cement bonded sand, the number of rods, arbors or other reinforcement is held to an almost negligible minimum. This feature not only effects a substantial reduction in the time required to make the core, but also reduces the time required to remove the core from the casting in the cleaning room. In this particular instance one of the main reasons for placing two 1-inch rod rings and a few other rods in the core is to



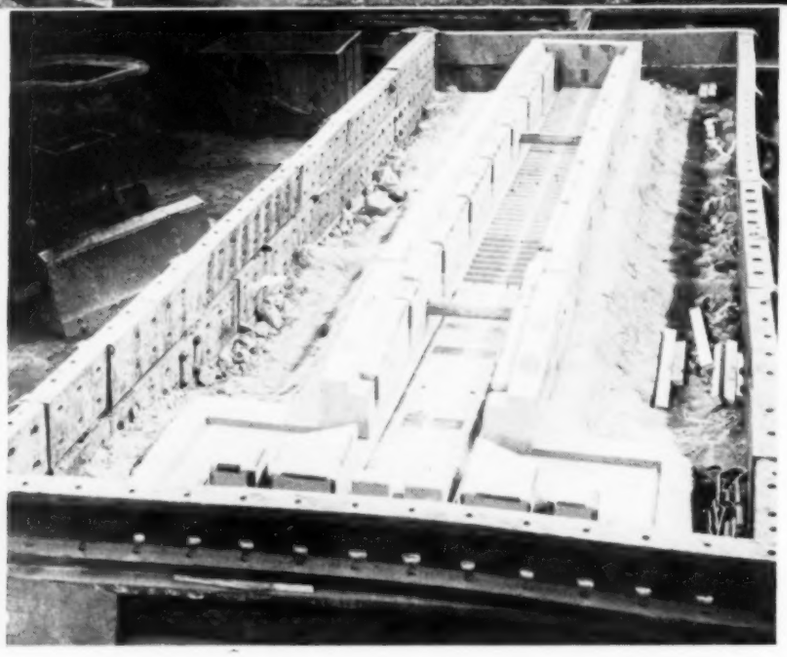


Fig. 8 (Top) — Long steel rack showing arrangement of gates and risers. Fig. 9 (Bottom)—Drag mold for the rack partly assembled

provide an anchorage for the hooks by which the core is lifted by the crane and placed in the mold. To provide for contraction of the casting, the core is merely a shell of sand filled with cinders, hence the necessity of suspending it by a greater number of hooks than would be necessary if the block was solid. In the mold the core is supported by the circumferential print and by a print in the center. With the core in place in the mold the hook holes are filled with cement bonded sand which unites with the surrounding material. In this respect the sand may be manipulated as readily as ordinary sand in filling holes or in repairing broken parts of the mold or core.

The core shown in Fig. 3 is allowed to remain in the corebox until it becomes sufficiently rigid to be lifted from the box and placed in the drag shown in Fig 1. Space between the core and the flask is filled with rubble topped off with a thickness of reclaimed sand bonded material. The mold then appears as in Fig. 4. A wood cover, the thickness of the upper plate in the casting, is placed on top of the core. A cope with approximately half the usual number of bars is placed in position. The widely spaced bars provide more than the usual latitude in choice of position for the runner and risers. Prepared sand is rammed in the cope in the usual manner, but the time required for this operation is reduced to a considerable extent for two reasons, first, because no hooks or gaggers are needed, and second because so many bars are out of the way.

After the cope is rammed it is allowed to remain in position for 24 hours, or until the cement bonded sand has solidified into a solid mass. The cope then is removed temporarily while the molder removes the wood cover from the core in the drag. The cope then is replaced, clamped to the drag, runner and (*Please turn to page* 72)

Fig. 10—Pouring a heat of gray iron in the same type of molds used for steel

Process Charts Reduce Costs

Record of every factor in a process is essential to conduct a proper analysis

By ALBERT J. SAUTE

THEORIES of motion study have been applied in foundries for some time and good results are obtained from their uses and applications. The part of motion study most useful for foundry work is the process or flow chart. A process chart, recorded in a proper manner by an experienced observer will show a correct picture of the work at the time the data for the chart were taken. The picture is a permanent record of the present method of completing the operation.

Method of making process charts is simple if the observer is motion minded. He first obtains his field data by going to the floor where the operation is to be completed. A brief study is made by the observer to see that the operator is working in the usual way. Then the elements for the process chart are recorded. The number and description of each motion and movement made by the operator are recorded in the sequence in which they occur. With each movement is also recorded the elapsed time and the distance traveled.

Data Printed on Blue Print Roll

The field data are printed on blue print forms for ease in manipulation and studying. For processes of regular length, such as a cycle on a molding machine, the blue print is a roll so that the entire picture can be spread out and seen at the same time.

Roll charts easily are filed and take but little space. Longer studies, charts on pattern making, etc., are printed on 8½-inch x 11-inch paper and are bound as a folio.

Process charts taken and compiled on coremaking and molding operations, show that much of the time spent by a high price molder or coremaker is taken up by work of a menial character. The coremaker on an average core job spends approximately 65 per cent of the total time on real coremaking work. The remaining 35 per cent of the time is taken up by getting coreboxes and loose pieces from the storage, sand at the mixing mill, gaggers and rods from the dump, fetching and cleaning core plates, pushing core oven cars, etc. Analysis of the charts also shows that 75 per cent of the total distance traveled by the coremaker is spent in the unskilled work. The distance traveled is the fatigue producing element that slows up the work and retards the production schedules.

All this kind of work can be done by men whose rate of pay is about half that of a skilled coremaker. The coremaker's output will increase substantially where he is relieved of the most fatiguing part of his work. A man will take more pride in the work he was hired to do and not have to spend one third of his time on disagreeable work. Process charts further show that the shop's production can be increased at least 25 per cent, with no addition of new equipment and with only a relatively small increase in the number of unskilled men.

On the whole process charts usually show that existing methods need revision. The revisions are accomplished simp- (*Please turn to page* 78)

Table I

Process Chart on Handling Scrap
Original Method

Element No.	Description	Men Skilled	Men Unskilled	Time in Hours Skilled	Time in Hours Unskilled
1	Collect spoiled castings, gates, scrap, etc., on floor	1	2	1.0	2.0
2	Load car (35 to 40 tons)	1	2	1.5	3.0
3	Couple car to switch engine	1	1	0.1	0.1
4	Switch engine takes car to ball breaker	1	1	0.2	0.2
5	Car uncoupled from switch engine	1	1	0.1	0.1
6	Car unloaded by locomotive crane with chains	1	2	1.5	3.0
7	All scrap moved under ball (utilizing ball hoist)	0	3	0	9.0
8	Breaking castings, etc.	0	3	0	9.0
9	Moving chargeable size pieces for loading into car	0	2	0	6.0
10	Car loaded by locomotive crane (with magnet)	1	1	1.5	1.5
11	Loaded car coupled to switch engine	1	1	0.1	0.1
12	Loaded car taken melting department	1	1	0.2	0.2
13	Car uncoupled	1	1	0.1	0.1
14	Car unloaded by melting dept. crane with magnet	1	0	1.0	0.0
	Total (hours)			7.3	34.3
15	Percentage added for uncharge-able size pieces (15 per cent)			1.0	5.1
				8.3	39.4

Power consumption at ball breaker, 65 kilowatts.

Fig. 1—Pots usually are mounted in gas or oil fired brick settings of the type shown. Puddling is accomplished with a sludge ladle or with a casting ladle

FOUNDING MAGNESIUM ALLOYS

By DR. JOHN A. GANN and MANLEY E. BROOKS

COMMERCIAL utilization of magnesium alloy castings, in many important industrial fields, warrants a more comprehensive description of the methods used in their production than is now available in American technical literature. The present paper will treat this subject primarily from the standpoint of the general methods used in the production of Dowmetal sand castings, beginning with melting, alloying, and casting; following on through heat treatment and surface finishing; and concluding with a brief summary of the properties and uses of this type of material.

Although many of the basic principles of foundry practice are common to most metals, differences in their physical and chemical properties necessitate marked changes in many details of operation These properties, in the case of magnesium, are lightness and chemical activity, particularly in the molten state. Lightness has exerted an effect on melting, alloying, and casting; while chemical properties have had a marked influence on the development of melting and casting technique, as well as on cleaning and surface finishing.

The first successful melting practice for magnesium developed in this country is known as the open flux pot melting practice. It has been used commercially for more than 15 years and is based on the use of a large bath of a fluid flux that functions in a dual manner. This flux protects the molten metal from the air and furnace gases by completely enveloping it and, thereby, eliminates the dangers usually associated with prolonged holding of metal in a molten state and with overheating. It likewise purifies the metal by washing out nonmetallic impurities when the metal and flux are intimately mixed. The flux normally used consists of 60 per cent anhydrous magnesium chloride and 40 per cent sodium chloride, and has a specific gravity and surface tension that causes it to float the metal as shown in Fig. 1. The main body of flux lies in a pool at the bottom of the pot; but a thin film is formed between the metal and the walls of the pot, and across the surface of the metal.

Melting pots are of low carbon cast steel. Cast iron is not leak-proof toward the flux and the heat resistant alloy steels do not show a service life commensurate with cost. Plain carbon steel pots are good for about 1000 hours of service. Their deterioration is due more to scaling on the outside of the pot rather than chemical attack from the flux on the inside. Pots holding 300 and 600 pounds of metal respectively are the size most generally used and are mounted in gas or oil fired brick settings as illustrated in Fig. 1.

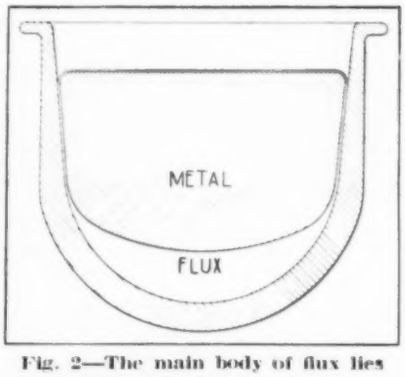


Fig. 2—The main body of flux lies in a pool at the bottom of the pot

The charge for the smaller pot consists of 100 to 125 pounds of flux and 300 pounds of metal, added in the order

named. The flux has a lower melting point than the metal and soon forms a bath to receive the metal as it melts down. The molten charge now is given a thorough puddling to bring metal and flux into intimate contact with each other, and thus insure complete removal of oxide and other nonmetallic impurities. Puddling is done with a sludge ladle, shown in Fig. 1, or with a casting ladle shown in Fig. 3. Contents of the pot are then allowed to stand quietly for several minutes that the impurities may settle from the metal and flux, and form a sludge at the bottom of the pot. Dry magnesium oxide is light and fluffy and shows little or no tendency to separate by gravity from the molten metal. However, it is readily wetted by the molten flux, whereupon it is compacted into dense sludge particles that settle to the bottom of the pot. The sludge is removed at regular intervals, generally once a day unless very large amounts of scrap metal are melted. It is dipped out with a sludge ladle, Fig. 1, and after pouring back the metal and supernatant flux in the ladle, the sludge is emptied into the sludge pans, likewise shown in Fig. 1.

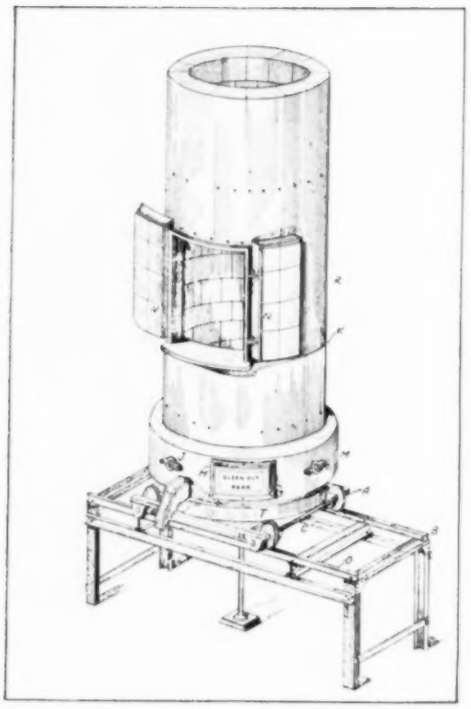
More metal is added as required to replace that removed in the production of castings. Each new charge is washed in flux as already described. While flux can be used repeatedly, there should always be enough present so that it readily can be brought to the surface of the metal during the puddling operation, and so that the casting ladle can be cleaned in the bath of flux below the metal, as explained later. Under normal conditions, one pound of flux is required for each 6 to 12 pounds of metal melted; this ratio depending on whether ingot or scrap is melted.

All material added to a pot of molten metal should be preheated carefully so that absorbed moisture may be driven off completely. The foundry flux is very hygroscopic and, hence, should be stored in covered containers and should not be added to a pot containing molten metal. This hygroscopicity likewise calls for careful preheating of all equipment, such as ladles, thermocouples, iron molds, and pans.

Scrap recovery is of particular interest and importance in the magnesium foundry because of the technique involved and because of the quality of the recovered metal. Massive scrap, such as sprues, gates, and risers, should be free from adhering sand and other contaminations. They can be melted the same as ingot, except that the metal should be washed more thoroughly with flux. Skim-gates will cause no harm in the pot and can be dipped out with the sludge. In the case of poor quality scrap, it is good practice to use two pots on the counter-current principle, namely, to melt in the one containing the older and dirtier flux and after a preliminary wash to transfer the metal to the casting pot containing clean flux and wash again.

Machine shop scrap, such as shavings, borings, chippings etc., present a different problem because of the greater ease with which such finely divided metal can be ignited and because of the high ratio of surface oxide to metal. Obviously, this type of scrap should be kept dry and, preferably free from oil or other cutting compounds. The practical solution of the shaving recovery problem consists in melting down the shavings at the lowest possible temperature, using plenty of flux and starting with a pot containing some metal in the pasty or semimolten condition. A shovelful of shavings then is added and quickly stirred into the flux. Stirring is not difficult because of the molten condition of the flux. The heat supply of the pot and the addition of shavings are so controlled (*Please turn to page* 91)

Fig 3 (Top)—Type of casting ladle for magnesium alloys. Fig. 4 (Bottom)—Preheated graphite mold used to cast samples for control of aluminum content in magnesium alloys



The upper part is suspended from the roof, while the lower part on wheels is mounted on a short length of track

How Some Foundrymen Solved Their Problems

Presents Detailed Data for Construction of Small Size Cupola

By H. W. Kelly
Western Foundry Co., Chicago

CONSTANT demand for a small unit for melting alloyed mixtures of ferrous and nonferrous metals for experimental purpose led the writer to design the cupola shown in the accompanying illustration. It is lined to 15 inches and therefore is too small for a man to work on the inside. For this reason the cupola is parted at the line *K*, or at the sill of the charging door. The upper part *R* may be suspended, while the lower part is rolled away temporarily for repair.

The shell is 22 gage steel with all joints electrically welded. The wind belt *M* is provided with four peep holes *J*, cast iron of standard design with mica windows through which melting conditions may be observed. If necessary a bar may be inserted through any of the openings to clear the tuyeres. Bottom doors of standard type, not shown, drop at the close of an iron melting heat. When the cupola is employed to melt metal in a crucible, the bottom doors are locked with a bar and wedges.

Distance from the bottom plate *T* to the charging door *N* is 28 inches. This cupola was designed to part at *K* for several reasons. One was the limited space. The second was the space did not allow tipping the stack. Third was the desire to melt certain nonferrous metals in the same manner as melting iron. Fourth reason was the necessity of occasionally introducing a crucible for melting expensive, or precious metals.

Outside diameter of the cupola shell is 24 inches. Outside diameter of the wind belt is 28 inches, and 6 inches high. Blast enters from a blower directly connected to the shell on top of the wind belt, but in the rear of the cupola and therefore not visible in the illustration. In this manner the blower requires no flexible hose connection when the lower part of the cupola is moved forward and back on the track. The wind belt has ample reserve capacity under the pressure built up by the blower. Two clean out doors, *H* are provided at diametrically opposite points to facilitate removal of slag or metal that may flow in from the tuyeres. The slag hole is on the opposite side from the spout.

The foundation or trestle upon which the lower part of the cupola is mounted, is made up of standard structural steel shapes, 4-inch channels, I-beams, flat steel and two narrow gage light rails *B*. The trestle is 4 feet in length and about 28 inches wide. The four flanged wheels *A* support the entire weight of the cupola.

Charging doors *N*, 12 x 16

(*Please turn to page* 84)

Two Articles Receiving Honorable Mention in The Foundry's Award Contest

Others Will Be Presented In An Early Issue

GRAY CAST IRON

By JOHN W. BOLTON

Chapter VI (Continued)

Effect of Antimony

THE element antimony is rarely if ever added deliberately to commercial irons, but small amounts may be traced to scrap charges containing white bearing metals and to some pig irons. Some of the antimony may persist through cupola remelting. The element possesses the following properties: Atomic weight, 120.2; melting point, 1166 degrees Fahr.; and density, 6.69.

It is claimed that antimony lowers the freezing range, the temperature of the separation of primary austenite and of the eutectic both being depressed. The temperature of the pearlitic, or eutectoid, transformation is not changed but the magnitude of the recalescence decreases with increasing antimony content. The structural occurrence of antimony in cast irons is not known although because it counteracts graphite formation it is thought to be soluble in the cementite.

Antimony addition lowers both static and impact strength quite rapidly. Rigidity is somewhat increased and brinell hardness is raised slightly. Depth of chill is increased markedly in low silicon low carbon iron (silicon 1.20 per cent, carbon 3.10 to 3.20 per cent).

In general antimony may well be considered a very undesirable impurity. Piwowarsky states that an iron containing only 0.19 per cent antimony was so brittle that it cracked when struck with a wooden hammer.

References

1—Kurnakov and Konstantinov, *Zeitschrift fuer Anorganische Chemie*, vol. 58, page 1, 1908.
2—Goerens and Elligen—*Revue de Metallurgie*, vol. 5.
3—Spencer and Walding—*Transactions*, American Foundrymen's Association, vol. 40, page 501, 1933.
4—Piwowarsky-Vladescu & Nipper—*Archiv. fur Eisenhuttenwesen*, vol. 7, pages 323-327, 1933.

Effect of Barium and Beryllium

APPARENTLY no extensive studies on the effects of either barium or beryllium have been made on cast iron. These elements are quite unlikely to be found in cast irons. Recently the action of beryllium in copper has attracted much attention. Through suitable age hardening treatment copper with 2.5 beryllium can be brought to 400 brinell hardness. Somewhat similar effects can be obtained in nickel alloys.

Both barium and beryllium are known deoxidizers when added in small percentages.

In most of its actions barium resembles calcium rather closely and somewhat similar effects may be expected. It is much more costly than calcium.

At the present time beryllium is very expensive, and it is doubtful whether it will find any extended use in cast irons for that reason.

Effect of Bismuth

DUE to its immiscibility, its low melting point and the fact that it oxidizes easily, bismuth is not found in irons as cast. Ladle additions indicate slight absorption of bismuth. The metal has the following properties: Atomic weight, 209.0; melting point, 520 degrees Fahr.; density, 9.75; and crystal lattice, rhombohedral hexagonal.

Bismuth and iron are immiscible in both solid and liquid states, according to Isaac and Tammann. Evidence on the effect of bismuth addition on the carbon formations in gray iron is conflicting. Nevertheless investigators agree that bismuth additions markedly weaken cast irons. Under some conditions bismuth has a distinct deoxidizing influence. W. F. Chubb, *Metallurgia*, December, 1933—states that bismuth up to 2 per cent acts as a deoxidizer and softener. It lowers tensile strength and brinell hardness but improves machining properties.

It is doubtful whether bismuth will ever be found useful in gray irons.

References

1—Isaac and Tammann—*Zeitschrift fuer Anorganische Chemie*, vol. 55, page 58, 1907.
2—Smith and Aufderhaar—*Iron Age*, pages 98-100, July 7, 1931.
3—Spencer and Walding—*Transactions*, American Foundrymen's Association, vol. 4, pages 502-503.
4—W. F. Chubb, *Metallurgia*, December, 1933.

Effect of Cadmium

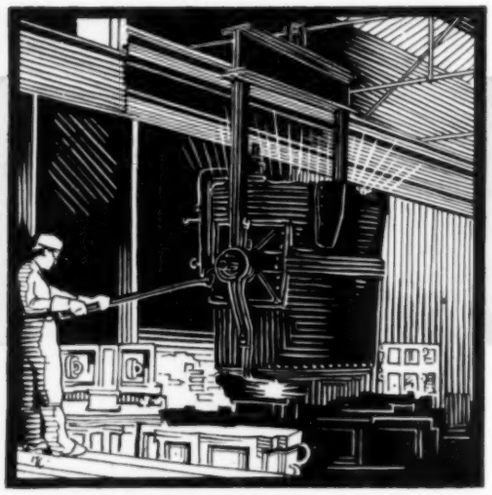
THE properties of cadmium are as follows: Atomic weight, 112.4; melting point, 610 degrees Fahr.; density, 8.64; and crystal lattice, rhombohedral hexagonal.

Cadmium is a very unlikely component in cast irons. Possible sources of contamination are cadmium plated metals and fusible alloys. Practically all cadmium added with the charge would be lost in cupola melting.

Spencer and Walding found that metallic cadmium exploded when added to cast iron. No marked changes in the properties of cadmium treated iron were noted. A slight lowering in transverse and impact strength and possibly some increase in chill depths were noticed. Its commercial utility in gray irons appears remote.

Effect of Calcium

CALCIUM has the following properties: Atomic weight, (*Please turn to page* 86)



Questions and Answers

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions from subscribers addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the advisory staff.

High Melting Point Metals Are Needed for Oven Bearings

We would appreciate information for bearings to be used in a baker's oven, having a maximum temperature of 500 degrees. We furnished our customer with a bearing of 85 per cent copper, 5 per cent tin, 5 per cent lead and 5 per cent zinc, which failed in operation. We then used an alloy of 88 per cent copper, 10 per cent tin and 2 per cent zinc, but the results were no better. When these bearings were returned to us we found no evidence of wear, rather they appear as if they were extruded, and we believe this is due possibly to the elevated temperature in which they are used. We have been told that the best metal that can be used for this purpose is copper. Do you believe that aluminum bronze, manganese bronze or a highly leaded bronze will meet the requirements?

Requirements you specify for the service of these bearings at 500 degrees Fahr. with an approximate load per square inch of 200 pounds, is a condition that precludes satisfactory lubrication. The usual lubricants do not give any lubricating value at any such temperature and, therefore, even though the load is only 200 pounds, a metal to metal contact is to be expected. On this account there is little likelihood that any of the bronzes would be satisfactory even though the revolutions are only 1½ per minute.

It would seem for this service that the conditions were so extraordinary as to require material of a higher melting point than the usual bronzes. It would seem desirable that a ball or roller bearing which can operate without lubrication would promise a more satisfactory service.

There is a possibility that with a steel journal of sufficient hardness, a cast iron bearing would give a reasonable life and cause little trouble; but even with this, there would be the necessity for some form of lubricant that would retain its lubricating value at the elevated temperature specified.

You suggest a possibility of aluminum bronze or manganese bronze. Neither of these would promise satisfactory results without lubrication. Manganese bronze or aluminum bronze are neither of them bearing alloys and, therefore would not be capable of giving long life. The high leads would undoubtedly give trouble at this temperature, although they might give apparently satisfactory service for a short period until they began to develop troubles arising from the elevated temperature. However, the slow speed required might permit of the use of the high lead with frequent renewals.

Fused Soda Ash Applied To Reduce Sulphur Content of Metal

Can you give us information on reducing and controlling sulphur in converter steel castings? We operate a 2-ton converter and are using 85 per cent railroad car springs and 15 per cent pig iron with sulphur under 0.05 per cent and coke also under 1.00 per cent. Our castings show a sulphur content of 0.06 to 0.083 per cent, and we would like to know how to reduce sulphur to the lowest possible point without changing our present setup in regard to coke, pig iron, scrap, etc. Other physical and chemical requirements are satisfactory.

Sulphur content in the steel castings may be reduced by cleaning the molten metal at the cupola with fused soda ash. There are several ways of applying the fused soda ash including adding it in the cupola, in a forehearth, and in the ladle. In addition, you may use combinations of those methods. In your case where the metal is reheated again by blowing in the converter, an effective sulphur removal may be obtained by what might be termed a 3-ladle process — employing three teapot type ladles containing various amounts of fused soda ash.

The first ladle into which the metal is tapped

from the cupola may contain about 20 pounds of soda ash per ton of metal. The molten metal is allowed to react with the soda ash for 7 to 15 minutes, and then poured into ladle No. 2 containing 10 pounds of soda ash per ton of metal.

The teapot ladle prevents the slag from entering ladle No. 2 so that the soda slag formed in the latter will not be contaminated. The molten metal in ladle No. 2 is permitted to react with the slag from 7 to 10 minutes, and then it is poured into ladle No. 3 which contains 5 pounds of soda ash per ton of metal. After a wait of 7 minutes the metal can be poured into the bessemer and blown as usual. In the succeeding batches which are treated, it is not necessary to renew all the sodium carbonate in each of the ladles. The renewal takes place only in the last or final ladle, and the slag skimmed from that is put back into ladle No. 2, and part of the slag from No. 2 is put back into No. 1, and that cycle is followed with succeeding batches.

Another method of desulphurizing is to use a forehearth at the cupola spout; the fused soda ash being added in the forehearth. Also some fused soda ash may be added with the limestone in the cupola. However, the most effective desulphurization is obtained by treatment in the forehearth or in the ladle as ordinary cupola slag decreases the efficiency of the fused soda ash. Consequently with the forehearth, the cupola should be slagged so that none of it is carried over with the iron.

Casting Defects Caused by Objectionable Elements in Scrap

We are sending a sample brass fitting having surface defects, caused by what we think is a lead silicide formation. We are melting No. 1 red brass scrap with additions of copper, lead and zinc. This has been our practice for the last year, and it is only in the past 2 months that this particular trouble has occurred. You will note that a decided disturbance of the metal also has taken place inside the surface of the casting. We believe this is not caused by hard cores directly, as we have tried various mixes of core sand, but rather is due to an impurity in the metal itself. Will you kindly give this fitting a careful examination and advise what you think might be the cause of the trouble?

Without analyzing the casting to determine the impurities, it is hard to offer an exact explanation. Surface defects would appear to be caused by presence of aluminum, probably in scrap; or, as you suggest, silicon may be present. Silicon bronze and aluminum bronze both are getting into scrap in large quantities now and the use of scrap is becoming increasingly dangerous in the production of good castings.

The use of a chemically controlled ingot produced by those who have the facilities to make a first class product is more uniformly satisfactory and the saving made by the use of scrap is more than made up in the reduction of defective castings. The only sure way to determine the explanation of your difficultiy is to analyze these castings. This should be done by those who are competent to make such an analysis. It has been found that many laboratories specializing in the analysis of steel and iron are not properly equipped or sufficiently experienced in analyzing nonferrous alloys to determine the presence of some of the troublesome impurities.

The defects exhibited on the inside are similar to those on the outside, and while they may be caused by a blow from the mold or the cores, they look more like the fold caused by the presence of aluminum or silicon. The casting indicates good molding and core making.

Mold Phosphor Bronze Pistons with the Heavy End Up

We are casting phosphor bronze pistons 30-inches long, 10-inches in diameter with a 6-inch core which hangs in from the top leaving a 2-inch metal thickness on the bottom and sides. The casting weighs 357 pounds. These are poured with two crucibles from the bottom, and we are having trouble with the metal eating into the sand. They do not wash or scab, but it is almost impossible to clean them, the metal eating into the facing sand. For facing we use a sand of approximately the same bond of 00 Albany and half Lexington sand with a small amount of sea coal and 1 to 30 pitch binder dampened with molasses water. We paint with dry black lead, and skin dry just enough to take the dampness from the surface.

The best practice would be to mold this piston with the heavy end up, with an ample riser attached to the heavy end to insure proper feeding; gating the casting from the bottom as you do now and letting the metal rise quietly into the mold until it fills over the core and finally rises through the riser. Such a condition not only would insure proper feeding, but would reduce the pressure at the point where the heaviest volume of hot metal is located; consequently reducing the tendency to burn into the facing of the mold and thereby correcting the difficulty you describe. Such a change in practice would also insure the soundness of the casting where the thin walls join the heavy end, which under the present conditions, probably are defective in some instances.

We believe your best method is to mold the casting the other way up and use your present facing with which you are now thoroughly familiar. A change from this facing would mean a new problem in your hands. The only additional precaution we would suggest, should you turn this pattern up, would be to be sure that your gating is such that the metal enters the mold quietly and does not become agitated.

Large Flat Core Blows in Thin Casting

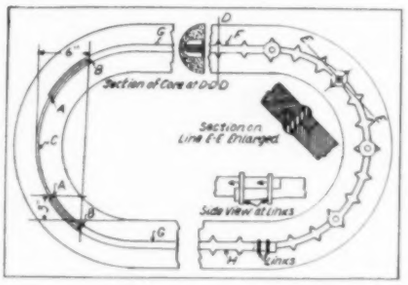
We are having difficulty in getting the gas out of the core in a water jacket. The core is 3 feet wide, 1¾-inches thick and is totally enclosed in the iron with the exception of one ½-inch and one ¾-inch opening. The metal thickness is ⅜-inch. The core sand mixture is made up of half and half Providence river sand and silica sand, bonded with oil in the proportion of 1 part oil to 25 parts sand. The interior of the core is filled with fine coke and in addition is well vented with ⅛-inch wax vents leading to the two openings. The casting is poured four up with four ¼-inch risers for the escape of gas. While pouring the casting, the gas flows freely from the vents until the mold is nearly filled with iron. Then the core blows violently.

The core in this water jacket presents a difficult and tricky problem. We doubt whether it is possible to provide a free exit for all the gas through the two small openings. It may be necessary to provide two or three additional openings, later to be tapped and plugged. The oil binder in the sand generates all the gas, therefore the amount should be cut down to the minimum, say about 1 to 40. Also the core should be dried almost to the point of burning. While the use of coke in the center of a core usually is commendable, it should hardly be necessary in the present instance if ¼-inch wax vents are substituted for the ⅛-inch variety. Objection to the coke is based on the fact that it weakens the core and hence involves the use of a great many chaplets. Even with the use of many chaplets, it is practically impossible to prevent a core of that kind from springing here and there and thus producing thick and thin areas in the casting walls. Several round or rectangular openings should be provided in the core to permit passage of the metal from the bottom to the top wall and thus relieve the pressure.

Construct Link Arbor For U-Pipe Core

Can you give me a description of a chain link cast iron arbor that can be removed without breaking from a 6-inch U-pipe, 6 feet in length and 30 inches center to center on the open or flanged end?

Several methods are available for constructing long arbors for U-pipes or other castings of a somewhat similar character. Detail of the joints and wings will vary to some extent depending on the size of the casting. The arbor shown to the right in the accompanying illustration will serve satisfactorily in a 6-inch diameter pipe 6 feet in length. The curved part is made up of four sections each 9 inches in length. The ends are lapped and joined by a rivet as shown in the sectional view on line *E E*. The long leg *F* is attached to the curved section is a similar manner and serves to pull the curved sections out of the castings after the



Alternative types of arbor for pipe

sand has been removed. The leg *H* in the other branch as shown at the bottom of the illustration is lapped and the joint is bound with two steel links. The lower lap is slightly wedge shaped and the links are driven up tight with a hammer in the direction of the arrows. After the core sand has been removed from the casting the links are driven back with a long steel bar. The long leg *H* then is removed through one opening in the pipe, and the curved part attached to the other leg *F* is pulled through the other opening.

However, such an elaborate core arbor is not required for the pipe in question. Sufficient reinforcement will be found in a single length of 2-inch steel pipe bent as shown at *G G*. to the left in the sketch. Two pieces of 1-inch steel rod or pipe *C* laid above and below the 2-inch pipes will complete the curved section. So long as the arc of these curved bars does not exceed 6 inches they can be pulled through the long straight part of the casting. Similarly, so long as the curved end of the long straight 2-inch pipes does not extend more than 3 inches beyond a continuation line of the inside wall of the casting, it can be pulled out.

Silica Brick Is Not the Cause of Defects

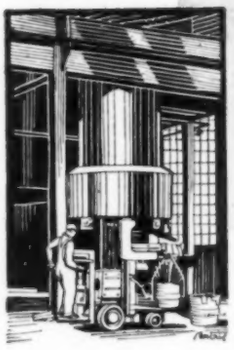
We have had some trouble with certain castings breaking and one of our metallurgists claims this is on account of using silica brick for patching the melting zone in the cupola. The cupola is lined with the usual type of fire brick and we use the silica brick for patching because we happen to have a quantity on hand that were ordered for another purpose and never used. Some of these brick are ground and mixed with the daubing material, while others are used in the original shape. The cupola is lined to 36 inches and the average daily heat is made up of 200 pounds gray iron pig, 6200 pounds gray iron scrap, auto cylinders etc., scrap steel plate 7300 pounds. The cupola is run in connection with a copper concentrator and smelter plant and the bulk of the iron is poured into white iron castings.

We fail to see on what grounds your metallurgist bases his opinion that a few silica brick in the cupola melting zone lining affects the physical characteristics of the castings. Steel melting furnaces are lined with silica brick without detriment to the composition of the metal, and it is a matter of common knowledge that molten steel is more susceptible than molten iron to contamination from material with which it comes into contact. If it were not for the cost and more particularly for inability to withstand hard usage, silica brick would be used as freely as fire brick for cupola lining. Their effect is neutral so far as the composition of the iron is concerned. In many cupolas in the East and Middle West silica stone is used exclusively for the lining.

Clay Content of Molding Sand Too High

We are forwarding a sample of molding sand and will appreciate your opinion on the adaptability of this sand for general gray iron castings ranging in thickness from ¼ to several inches.

Submitting this sample to the quick or bottle test originated by the late Eugene W. Smith and described in his book *Foundry Sand—Its Uses and Abuses* we find that the clay or bonding material is in excess of the remainder. Approximately the same condition is noted when a ball of the sand is squeezed in the hand. From the foregoing it is apparent that the sand is not well adapted to foundry use, except possibly as an addition in small quantities to heaps in which the bond is low. The excess of bonding material while excellent in taking the impression of the pattern and in securing a good lift in the cope, will prevent the free escape of the vent, that is reduce the permeability and will promote the formation of scabs and blowholes in the castings. Excess of bonding material also will reduce the refractoriness of the sand with the result that the surface sand will fuse and unite with the iron. However, the foregoing merely represents an opinion based on a superficial examination. The most satisfactory method of arriving at a definite conclusion would be to make a few molds with the sand.



Viewing Foundry Developments . . . AT SHORT RANGE

THE newest adjunct to the wide variety of foundry equipment will be refrigeration if our ears do not deceive us, for we hear that a Russian laboratory has investigated the use of frozen molds and cores. It is claimed that heat conduction of those is less than iron chills; and that the permeability and strength are greater than for green sand. Also use of frozen molds and cores eliminates shrinkage cavities in intricate castings.

• • •

Removal of copper oxide from molten copper may be accomplished, according to a recent patent, by pouring it from a height into a molten slag containing 65 per cent TiO_2; 20 per cent SiO_2, and 15 per cent MnO_2. If phosphorus or silicon is used previously as a deoxidant, the slag may contain 25 per cent Na_2O; 45 per cent CaO; 15 per cent MnO; 10 per cent FeO, and 5 per cent MgO and Al_2O_3.

• • •

FOR long production jobs many firms are finding it advantageous to apply a plating of chromium 0.005-inch thick to their iron patterns and coreboxes. The process is rather expensive, for example, it is stated that the expense of chromium plating an automobile cylinder pattern is approximately $200, but that is a negligible item on a pattern used for the production of 250,000 castings.

• • •

In a prominent mid-west pattern shop a special type flask has been developed for molding aluminum patterns. Former experience seemed to indicate the practical impossibility of securing straight, flat plates, or uniform thickness in other patterns made in wood flasks. The present metal flask is machined on the joint and the cope is provided with permanently bolted bars 2 inches in depth. Strips of metal 2 inches wide are bolted vertically to these bars at any height to correspond with the upper surface of the pattern. For example on a flat plate, the strips extend to within ¼-inch of the face. Over patterns which extend to any given height in the cope, the strips are adjusted to fit. In this manner a flask may be adjusted repeatedly to suit a wide variety of pattern shapes.

• • •

LADLE bottom tiles, consisting of circular disks made from a special refractory mix and designed to fit practically any size of ladle from small hand ladles to large reservoir ladles, recently have been developed. It is claimed they are easy to install, eliminate chipping and fitting of split brick, and the risk of metal going through joints in the bottom. The tiles also provide a dry bottom.

• • •

An extensive series of tests on a variety of materials for worm gear purposes indicated that a chill-cast nickel-phosphor-bronze ranked first in resistance to wear and deformation. The composition with which the best results were obtained was 87½ per cent copper, 11 per cent tin, 1½ per cent nickel, and 0.1 to 0.2 per cent phosphorus. The tests were carried out on a Prony brake.

• • •

A process for hardening cam surfaces of cast iron camshafts, according to a recent patent, involves rapid heating electrically, and cooling in air, water or oil. Heating is through resistance, the cam being placed between two electrodes. Speed of operation is one of the features, it being stated that a camshaft with 10 cams can be treated in 30 seconds. Hardness can be controlled by adjustment of rates of heating, final temperature, and rate of cooling.

• • •

Improvement of cast iron, particularly that made from high scrap mixtures, results from the use of silicon carbide. As described in a patent the silicon carbide preferably is added with the iron in the cupola although benefit is obtained through ladle additions. The amount to be used ranges from 6 to 15 pounds per ton of metal, and in the higher ranges claims are made for a lower sulphur content; reduction in coke required for melting; more uniform structure; increase in spout temperature, and more fluid iron.

• • •

To increase the carbon content and reduce the sulphur content of cast iron, particularly that made from scrap that has been remelted numerous times, a recent patent describes treating the molten metal with carbonaceous material plus an oxidizing agent. The carbonaceous material may be graphite, charcoal, etc., mixed with 15 to 30 per cent sodium or potassium nitrate. Proper carbon addition is obtained by adding twice the theoretical amount required.

• • •

SINCE core dryer shells are exposed to comparatively high temperature in service, with consequent expansion and possible distortion,

it is essential that these castings should be normalized by suitable heat treatment before they are machined or hand tooled to the required degree of accuracy. In practice it has been found that for the usual aluminum alloy pattern metal, soaking for 6 hours at a temperature of 550 degrees Fahr. produces satisfactory results.

E. O. Jones

W. W. Rose

Vincent Delport

Men of Industry

WILLIAM WATTS ROSE recently was elected vice president of the Gray Iron Founders' society with offices in Cleveland. Following his resignation from the U. S. army in 1919, Mr. Rose entered the employ of the Bethlehem Steel Co., Bethlehem, Pa. Later he was given charge of that company's interests in Brazil and was made vice president of the Bethlehem Steel Co. of Brazil. During his residence in Rio de Janeiro, Mr. Rose was consecutively a director, vice president and president of the American chamber for Brazil.

In 1926 Mr. Rose resigned from the Bethlehem Steel Co. and accepted a position with the Delco-Light Co. and, later, the Frigidaire Corp., subsidiaries of the General Motors Corp. He organized the set-up of those firms in the territory extending from the Mediterranean to and including India, Burma and Ceylon. Later, he was made regional manager in charge of this territory.

In 1931 the regional office was closed and after engaging in consulting work in New York Mr. Rose became associated with the American Sealcone Corp. in that city as assistant to the president. He was engaged in that work until called to Washington in 1934 to assist in certain administrative government work. He resigned this position to join the Gray Iron Founders' society. Mr. Rose is 52 years of age and was graduated from West Point in 1906.

ELLSWORTH O. JONES recently was made director of the newly formed safety and hygiene section of the American Foundrymen's association. Mr. Jones was born in Racine, Wis. in 1893, and was educated in the public schools of that city. He then became associated with the Industrial Crushed Stone Co., Racine, and remained with that organization for 2 years. Following this, he became an apprentice with the J. I. Case Co., Racine, advancing through various positions and serving continuously until 1922, except for a 2 year period during which he was overseas with the 121st heavy field artillery.

In 1922 Mr. Jones accepted the position of purchasing agent, Belle City Malleable Iron Co., Racine, and held that position until 1934 when he became consultant for the industrial relations bureau, National Founders' association. He is widely known through his work with national and state organizations on the study of industrial dust problems.

VINCENT DELPORT, European manager of THE FOUNDRY and managing director, Penton Publishing Co. Ltd., Caxton House, London, England, and European representative of the American Foundrymen's association, has been elected vice chairman of the International Committee of Foundry Technical associations. This committee controls and schedules international foundry congresses, the next of which will be held in Dusseldorf, Germany, Sept. 15 to 20, 1936.

Membership in the International committee is composed of representatives of foundry technical associations of the United States, Great Britain, France, Germany, Czechoslovakia, Holland, Italy, Poland and Spain. Mr. Delport has been the American Foundrymen's association representative on the committee for several years and the honor recognizes his distinguished services at various international congresses.

Born in London, England, in 1888, Mr. Delport received his education in France, graduating from the University of Paris with a bachelor of science degree and from the Ecole Centrale des Arts et Manufactures, Paris, as metallurgical engineer. During the War he served with the French army in the artillery and was awarded the Croix de Guerre. He came to the United States in 1917 with the Tardieu mission and after the Armistice, was attached to the French high commission in New York.

Following the war, Mr. Delport became associated with the United States Steel Products Co. in New York and Paris. From 1921 to 1923 he was con-

sulting engineer and manufacturers' agent in Paris. He was appointed French correspondent for the Penton Publishing Co., Cleveland, in 1922 and became manager of the Penton Publishing Co. Ltd., London, European subsidiary of the American company in 1924.

Mr. Delport was appointed European representative of the A.F.A. in 1925 and has served as a member of its International Relations committee for some years. In addition, Mr. Delport is a member of the Association Technique de Fonderie de France, British Iron & Steel institute, Institute of British Foundrymen and Societe des Ingenieurs Civils de France.

LLOYD J. BOHAN has been added to the Chicago sales force of the Michiana Products Corp., Michigan City, Ind. His headquaters will be at 80 East Jackson boulevard, Chicago.

H. D. FARRIS, since 1922 active in the promotion and sales of cereal binders, has been appointed eastern sales representative of the Great Lakes Foundry Sand Co., Detroit.

R. L. MEAD has been made manager of the Chicago office of the Harnischfeger Corp., Milwaukee, with headquarters at 20 North Wacker drive, Chicago. Prior connections include Industrial Brownhoist Co., Ohio Locomotive Crane Co., McMyler Interstate Co. and the Link-Belt Co.

DANA D. BARNUM, president, Consolidated Gas Co. of Boston, was elected president of the American Standards association recently, succeeding HOWARD COONLEY, president of the Walworth Co. EDMUND A. PRENTIS, Spencer, White & Prentis Inc., was elected vice president.

ALBERT J. SAUTE has purchased the Randolph Iron Foundry, Pleasant street, Randolph, Mass. and is operating a jobbing shop for light and medium castings. YALE D. SAWTELLE, formerly foreman, General Electric Co., Lynn, Mass., and General Alloy Foundry, Boston, Mass., is the shop superintendent.

J. ERLER, metallurgist, Farrel-Birmingham Co., Ansonia, Conn., will present the annual exchange paper of the American Foundrymen's association at the International Foundry congress to be held in Dusseldorf, Germany, Sept. 15 to 20.

Mr. Erler was born in Leipzig, Germany, Oct. 13, 1900, and attended high school there. He received his degree from Berg a Kademie, Frieberg, Germany. From 1926 to 1928 he was chemist with the Carus Chemical Co., La Salle, Ill., and then went with the Wilson Foundry & Machine Co., Pontiac, Mich., as metallurgist. In 1930 he became sales engineer with the Eastern Clay Products Co., Buffalo, and became connected with the Farrel-Birmingham Co. in 1932. He is the author of numerous papers and articles for technical societies and the business press and is a member of the American Foundrymen's association, the American Society for Metals and the Verein Deutscher Giepercifachleute, Germany.

John Erler

JAMES S. DUNCAN has been made general manager of Massey-Harris Co., Toronto, Ont., succeeding B. W. BURTSELL who recently resigned. Mr. Duncan has been connected with the Massey-Harris Co. for many years and since June, 1935, has been assistant general manager. Mr. Burtsell will remain with the company as director and vice president.

CHESTER F. HOCKLEY, president of the Bartlett-Hayward Co., Baltimore, since 1931, has retired to become president of the newly organized Davison Chemical Corp. He will continue as a director of the Bartlett Co.

WALTER F. PERKINS, formerly vice president and general manager, will succeed Mr. Hockley as president of the Bartlett-Hayward Co. Mr. Perkins first became connected with that company in 1914, filling various positions up to that of general superintendent. In 1927 he retired from that position to become manager of the Harrison works, Worthington Pump & Machinery Corp. In 1932 he returned to Baltimore as vice president and general manager of the Bartlett company.

GEORGE E. PROBEST JR., formerly secretary and treasurer, has been elected vice president and treasurer.

HERMAN H. VORDEMBERGE has been made secretary and assistant treasurer. He previously was assistant secretary and assistant treasurer.

CHARLES L. CRUIKSHANK has been appointed manager of the ceramic department, Great Lakes Foundry Sand Co., Detroit. Mr. Cruikshank is a graduate of the University of Michigan, and has been interested in the nonmetallic minerals industry for several years. He will be engaged in the sale of nepheline syenite, a new ceramic raw material.

JOE D. DUFFIELD recently was made assistant foundry superintendent, General Motors Corp., Pontiac Motor Co., foundry division, Pontiac, Mich. Mr. Duffield was foundry efficiency engineer and assistant superintendent of the Belle City Malleable Iron Co., Racine, Wis., from August, 1927, to February, 1932. Since 1933 he has been connected with the Chrysler Motor Corp., Dodge Bros. plant, Detroit.

A. S. WRIGHT, assistant metallurgist, Hunt-Spiller Mfg. Corp., Boston, recently was elected president of the New England Foundrymen's association. Mr. Wright has taken an active part in the affairs of the association for some time.

He was born in Boston and received his early schooling in the public schools of that city, and was graduated from Northeastern university. He has been employed continuously since 1914 in the metallurgical department of the Hunt-Spiller Mfg. Corp., originally as chemist and in more recent years as assistant metallurgist.

Mr. Wright was one of the early workers in the field of conservation and reclamation of molding sands and the technical control of sands in the foundry. He also has been active in fundamental research as applied to the problems of foundry metallurgy.

THOMAS N. ARMSTRONG JR. recently became connected with the technical staff of the International Nickel Co. Inc., New York, and will handle the steel castings development for that company. Mr. Armstrong has presented various papers before the American Society for Metals and has made numerous contributions to the technical press. He formerly was as-

sociate metallurgist, Norfolk Navy yard, Portsmouth, Va. and prior to that spent several years with the Andrews Steel Co., Newport, Ky. in open-hearth furnace work. He is a graduate of the University of Kentucky with a degree in metallurgical engineering.

C. R. MESSINGER, chairman of the board, Oliver Foundry Equipment Co., has been elected president of the company, succeeding M. H. PETTIT, who has resigned as president and director.

CARL GRAY, for 10 years advertising manager and the last 6 years in charge of merchandising, B. F. Sturtevant Co., Hyde Park, Mass., has been appointed district sales manager of the southern territory of that company, with headquarters in Atlanta, Ga.

GLENN HAMILTON, formerly superintendent of the gray iron foundry, Hart-Parr Co., Charles City, Iowa, and for many years connected with the foundry industry, has been appointed foundry superintendent of the new gray iron foundry of the Budd Wheel Co., Detroit.

CAL C. CHAMBERS has been made general manager of the Southern Malleable Iron Co., East St. Louis, Ill., succeeding V. S. DURBIN.

HERMAN N. BRIEN, a practical all-around iron foundryman, has joined the staff as sales engineer.

CHARLES S. BUNTING, metallurgist and chemist, has been placed in charge of the recently installed laboratory for the scientific testing of materials and manufacturing processes.

C. S. DAVIS, president, Borg-Warner Corp., Chicago; CHARLES R. HOOK, president, American Rolling Mill Co., Middletown, O.; GEORGE H. HOUSTON, president, Baldwin Locomotive Works, Philadelphia; N. W. PICKERING, president, Farrell-Birmingham Co., Ansonia, Conn.; S. WELLS UTLEY, president, Detroit Steel Casting Co., Detroit; HOMER L. FERGUSON, president, Newport News Shipbuilding & Dry Dock Co., Newport News, Va.; and WALTER J. KOHLER, president, Kohler Co., Kohler, Wis., were elected vice presidents of the National Association of Manufacturers recently.

T. T. JOHNSON has been appointed sales metallurgist for the Republic Steel Corp. pig iron division. He will be attached to the Birmingham, Ala., district.

After completing a specialized education in industrial chemistry, Mr. Johnson became associated with the United States Pipe & Foundry Co., as chemist at the Bessemer, Ala. works. From 1909 to 1920 he was chief chemist and had charge of cupola and melting. From 1920 to 1921 he was assistant general superintendent and then was made general superintendent. He continued in that capacity until his recent appointment.

Albert E. Grover

ALBERT E. GROVER, cost consultant, Berea, O., has been appointed to the advisory staff of THE FOUNDRY, *effective Feb. 1. Mr. Grover's long experience and far-reaching knowledge of foundry cost accounting will be available in an advisory capacity with particular reference to the Question and Answer services of* THE FOUNDRY *devoted to cost problems.*

Mr. Grover started his cost accounting work with the Geneva Metal Wheel Co., Geneva, O., in 1904. *Seven years later he was employed by the firm of Nau, Rusk and Swearingen, Cleveland, certified public accountants. During the 8 years he was connected with that company he specialized in foundry work.*

He then became comptroller, Dunham Co., Berea, O., where he remained until 1921 *when he returned to the professional field, being employed as cost manager, Kohr, Brubaker & Fisher. A short time later he established his own accounting practice and in* 1928 *he became connected with the National Machine Tool Builders' association where he undertook to standardize the cost finding methods in use in the shops of the members.*

Three years later he was named cost director of the Gray Iron institute where he was active in the standardization of cost practices. During the past 2 years he again has been engaged in private consulting practice.

In addition to Mr. Grover, the advisory staff of THE FOUNDRY *includes: John W. Bolton, Lunkenheimer Co., Cincinnati, O.; John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; Harry A. Schwartz, National Malleable & Steel Castings Co., Cleveland; and N. K. B. Patch, Lumen Bearing Co., Buffalo.*

Outlines Features Of Rotary Type Furnace

W. R. Bean, Whiting Corp., Harvey, Ill., was the principal speaker at the January meeting of the Northern Illinois Foundrymen's association, held at the Elks club, Rockford, Ill., Jan. 14. H. S. Beenethum, Stover Mfg. & Engine Co., Freeport, Ill. presided.

Mr. Bean spoke on the Brackelsberg furnace, and stated that best results are secured when a unit is fired with pulverized coal. The furnace is rotated continuously during the melting, starting 30 to 40 minutes after firing is begun. Fuel consumption was stated to compare favorably with the cupola, being a 6 to 1 ratio.

The speaker pointed out that the furnaces now being installed with air preheating systems utilize waste gases. It was stated that these installations can be charged and tapped by the clock without test, giving very close control and uniform results. Furnace atmosphere is controlled and no difficulty is experienced in reaching a temperature of 3000 degrees Fahr., although the lining life is greater at a temperature of 2800 degrees Fahr. Silica brick is used in the lining, backed by a 6-inch clay brick permanent lining. Lining costs run about 34 cents per ton, including a week end retaining fire.

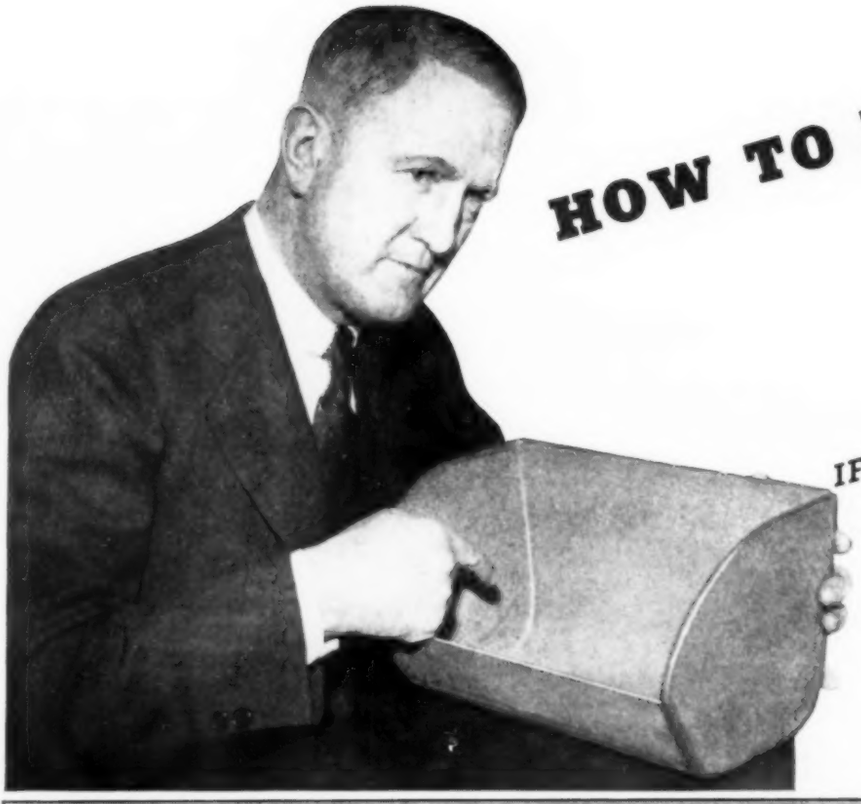
The point was brought out that a high ratio of scrap could be used in the charge. Comparative operating costs were given. The loss of elements in iron was stated as 1.25 per cent. Mr. Bean pointed out that the furnace is used on a wide range of work in this country including gray iron, malleable and copper silicon steel. It is used for plain carbon steel abroad.

Societies Merge

Taylor society, founded in 1915 and the Society of Industrial Engineers, founded in 1918, have merged under the name "Society for the Advancement of Management." Headquarters are at 29 West Thirty-ninth street, New York.

Moves Detroit Office

Hanna Furnace Corp., merchant pig iron division of National Steel Corp., has removed its Detroit office to the Great Lakes Steel Corp., Ecorse, Mich.



HOW TO HANDLE IT

IF IT IS MOLDING SAND

It's Just a Bucket . . . But It's The Key

● The Rex foundry sand bucket was developed in a foundry—the foundries of the Chain Belt Company, where more than 600 tons of castings are produced monthly. Its special shape is such that it is self-cleaning, automatically dumping all of its load. The old "V" at the bottom where the sand used to stick is gone.

The Rex Foundry Bucket is only one item in the Rex Foundry Sand Handling Systems that offers the better design leading to better operation which reduces foundry costs.

Waiting to be sent to you is a new book, "How to Handle IT," which shows some 40 examples of material handling in some 20 industries. A companion, "How to Drive IT," tells a similar story on power transmission.

REX

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Chain and Belt Conveying

Pig Iron Is Made in Smaller Size

By G. A. T. LONG and W. M. RAMSEY
Pickands, Mather & Co., Cleveland

DURING the latter part of 1935, Pickands, Mather & Co. introduced a new type of pig iron merchandised under the name Meltrite. This new type of pig iron, while of customary length, is of much smaller cross-sectional area and weighs but about 40 pounds per pig. This change in pig size constitutes a remarkable development in the trade in recent years, and, naturally, many foundrymen have asked why and for what purpose the change was made. The answer lies in the name of the new pig iron—Meltrite. The new pigs were designed primarily to give improved melting qualities in foundry practice.

Not so many years ago, foundrymen were melting pig iron cast in sand, normally about 26 inches long and ranging in weight from 75 to 150 pounds. In fact, sows of 200 pounds were not uncommon.

Machine Cast Pig Iron

Experiments were conducted in the late '80's in the casting of iron in chilled molds, but it was not until the early part of the twentieth century that machine cast iron became a generally accepted product. As the use of machine cast pig iron increased, a reduction on foundry losses was noted. Recent investigations have indicated that the primary reason for this was the greater uniformity in size of pigs made possible by mechanical casting. That this was a definite forward step is now an accepted fact, but the importance to the melter of uniformity and size of the pig was not realized fully at that time.

With the turn of the century, the pig iron and foundry industries, along with the steel industry as a whole, underwent a radical change in the attitude toward their products. In the first place, the great pioneering period of the country had come more or less to a close; railroad building had reached the Pacific coast and turned back; the development of new lands had passed its climax; the uncritical demand for materials and still more materials dwindled. Consumers began to ask for the specific product which would suit their needs and requirements best.

The iron and steel industry as a whole awoke to the fact that vast new problems of production and marketing were in the making. Research came to the front. The science of metallurgy assumed its proper position in the industry. There began a phase of intelligent and selective production and anticipation of consumers' needs, which has been accelerating constantly in the foundry industry, and which during the recent years, has reached proportions never before known.

The pig has a smaller cross sectional area and weighs 40 pounds

At first, emphasis was placed upon chemical rather than physical characteristics. The spread in analysis was reduced to narrow limitations to meet the more exacting requirements, but the physical characteristics of the iron remained practically unchanged.

Research as to the importance of certain physical properties in metals was delayed largely because the significance of the properties was not realized. It is only within the last few years that the tremendous significance of grain structure has come to the fore. The study of grain structure and the realization of the important bearing which grain structure has upon workability, strength, and other characteristics of the finished iron product led to a study of the reducing practice in the blast furnace and an investigation of the cooling conditions encountered in the preparation of pig iron on a pig casting machine, as well as the melting practice in the foundry. It was the careful study of blast furnace and foundry practice that led to the development of the new pig.

The modern foundry is expected to produce castings of uniform excellence—castings which will meet the exacting specifications of the buyer. However, absolute uniformity is difficult to obtain since there are too many variables.

If the respective constituents of a charge were alike as to size and analyses, it is conceivable that the charge could be melted and mixed and the metal delivered at the spout with an approximately perfect degree of uniformity. But variations in analysis are often extreme and weight and dimensional variations range from ounces to over 100 pounds.

Secure More Uniformity

While all variables cannot be controlled, pig iron is one of the constituents which can be changed. Heretofore the pig has been extremely heavy. By bringing the weight of the pig closer to the weight average of sprue, scrap and other constituents, it is believed there is a much better probability of a larger degree of uniformity in melting.

Constancy of composition in the stream of hot metal as it comes from the cupola always has been the ideal. What foundryman has not figured ways and means—a larger basin below the tuyeres, a better mixing ladle, a smaller charge, and what not— to reach a degree of uniformity where, ideally, a "catch-in" with a hand-shank is just as good as any other way. Of course, lighter pigs alone will not necessarily produce this ideal condition—but insofar as excessively large pigs magnify the trouble of irregular composition, it seems obvious that smaller pigs will minimize it.

Another difficulty which foundrymen experience at times is one which is closely connected with cupola oxidation—a prolific producer of troubles— and of losses. For many years, melters have found that certain castings show pin holes, cavities and other troubles not easily explainable, and seemingly not connected with the

(*Concluded on page* 46)

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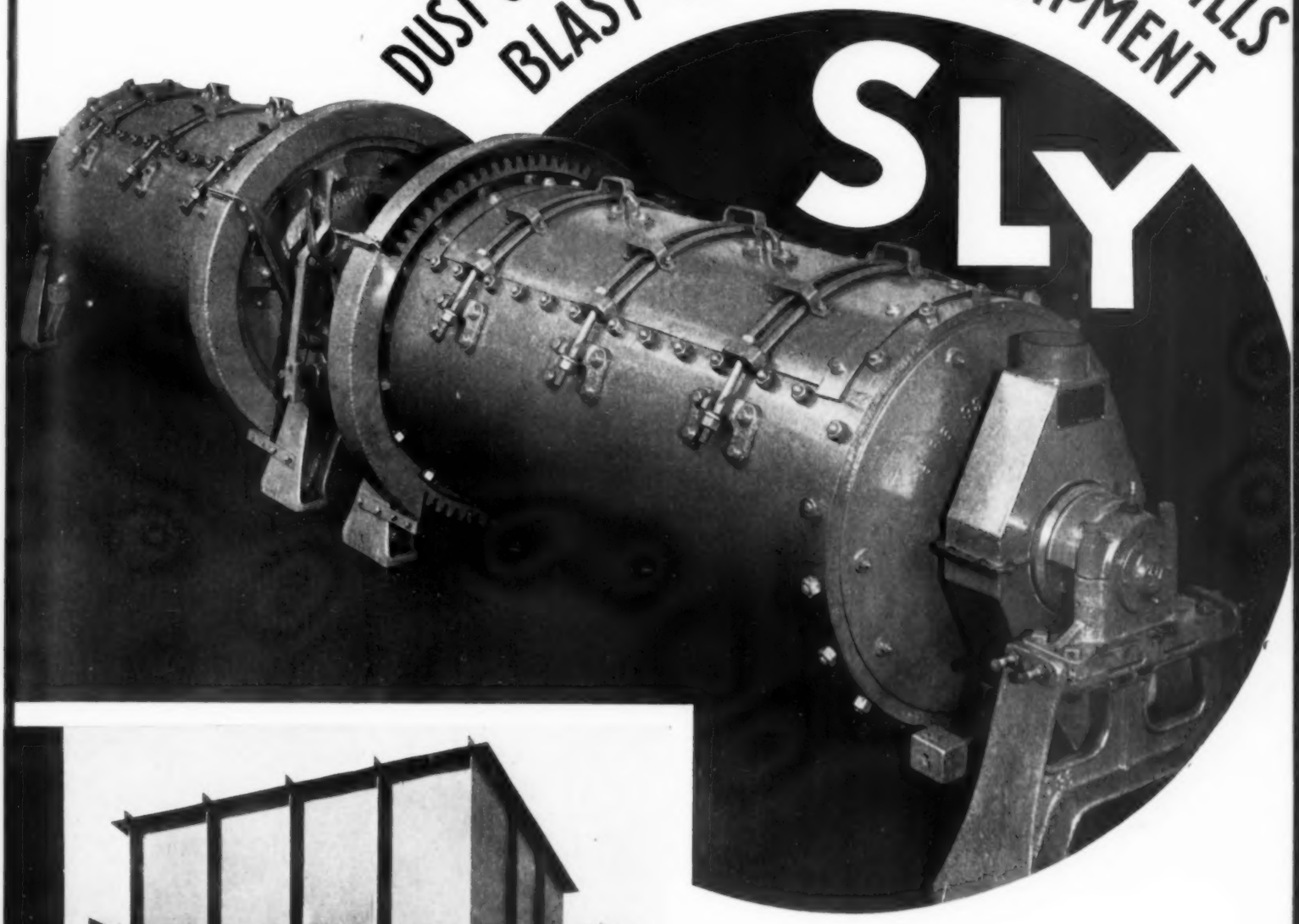

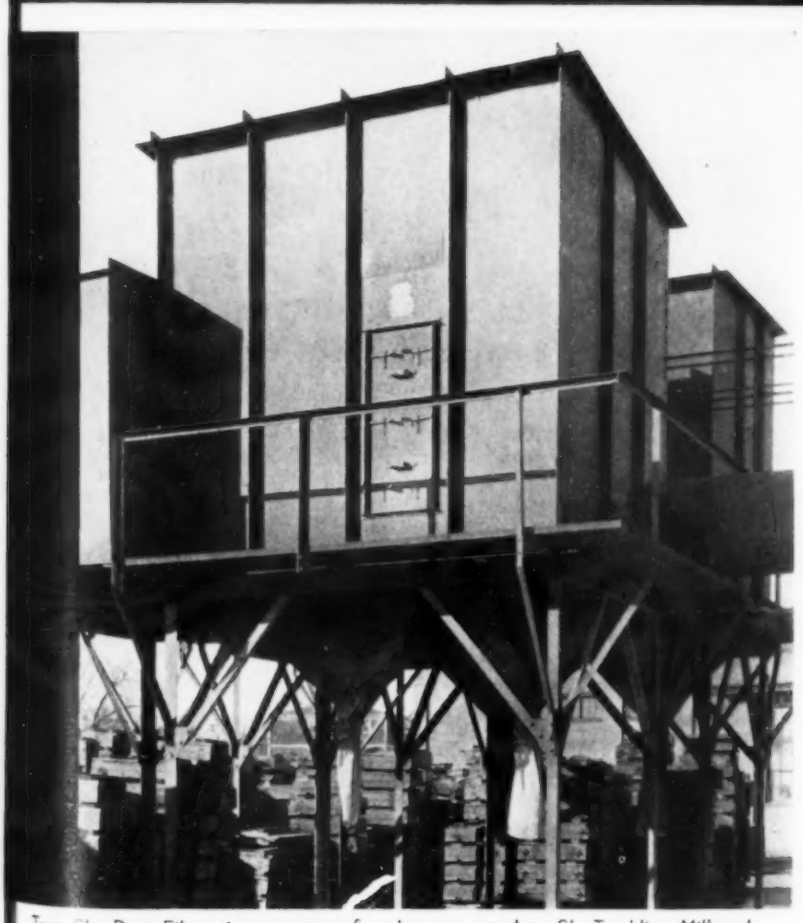

Two Sly Dust Filters in an eastern foundry, connected to Sly Tumbling Mill and and Blast-Cleaning equipment. This is but one of many thousand Sly installations.

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(*Concluded from page* 44)

usual causes for such troubles. In many instances, foundrymen attributed that condition to inferior pig iron,—oxidized pig iron was the term used. How misleading this phrase is, is understood when one realizes that a blast furnace is not an oxidizing agency. Blast furnaces take oxygen away from iron ore, reducing it to pig iron. It is true that under certain conditions oxidation of iron will occur to a limited extent within the blast furnace, but probably never to the extent that oxidation within the blast furnace can be blamed for foundry difficulties. Authorities agree that the excessive oxidation long complained of by foundrymen occurs in the melting agency itself, that is, the cupola or air furnace, and that it occurs when and if free oxygen meets incandescent iron.

Let us examine one way in which this oxidation within a cupola can occur. Air is blown into the cupola so that oxygen may combine with carbon (coke) and thereby release heat for melting. More air than is necessary from a chemical standpoint is supplied. Otherwise, melting would be slowed down considerably. Many metallurgists and foundrymen believe that if a number of heavy pieces of metal of large cross-sectional area are in the charge these melt more slowly than the average and tend to drop below the melting zone. While this may not occur if the coke bed is kept high, in actual practice the coke bed is not always kept high. In this case large pigs may meet with free oxygen contained in the blast at the tuyere zone while still in an incandescent state. When this occurs the incandescent iron will burn like a white pine match. Drops of burnt iron (magnetic oxide of iron Fe_3O_4) reach the bath of molten iron and contaminate the bath with *oxide-in-solution*.

Cause Defective Castings

The molten iron then is poured into a mold and some sections freeze at once. Large sections may have plastic boundaries with fluid interiors, and a chemical reaction occurs between the newly formed graphite and *oxide-in-solution* with the quick resultant of a bubble of CO gas. This bubble breaks away, and like any other bubble in liquid, rises to the highest possible point, which is generally just beneath the upper surface of the cope. All foundrymen know that excessive *oxide-in-solution* means losses.

Not all pin holes caused by oxides —whether they are in solution, or in any other of the much disputed forms—are due to excessively heavy pigs. On the other hand, it seems probable that some of the trouble with oxides at least is caused by heavy pigs—and it is believed that unduly heavy pigs tend to lessen uniformity of the metal because they increase variations in weight of the constituent parts of the charge.

Starting with this theory as a basis, the metallurgists who developed the new type of pig set out to determine the relative dimensions of pigs which would be conducive to the best and most uniform melting in foundry practice. Careful experimentation led to the conclusion that the size of pig which should help to overcome foundry difficulties was one with the same length as the old style pig, but much less in depth and width.

First of all, uniformity of size itself tends to produce uniformity in melting. However there is also an element of uniformity in addition to that supplied by size alone. Relative dimensions of the pigs are most important. In the new pig the trapezoid shaped cross-sectional height approximates the mean transverse sectional width of the pig. This means that heat will reach the interior of the pig at approximately the same time from all directions.

Minimize the Cause

These two characteristics, uniformity of size and uniformity of proportions, it is believed should increase the uniformity of melting in the cupola or air furnace, and should tend to minimize one of the common causes of the oxidation of iron.

The experience of various foundries which have tried the new pigs indicates a number of other advantages to be gained. One of the most important is increased melting speed brought about through more surface being exposed per unit of weight. The new type pig has nearly $1\frac{1}{2}$ times as much surface per pound of metal exposed as in the case of standard iron. It has been found this results in a substantial reduction in melting time with a consequent increase in output per hour.

As previously stated one of the most important research developments of recent years has been the discovery that physical characteristics of iron and steel raw materials as well as chemical content, have a marked effect upon the desirability and utility of the final product.

In the final processes used in the manufacture of the new type of pig iron, there has been developed a higher degree of grain control and with this a more refined grain structure than was formerly possible.

There appears to be considerable evidence that this improved grain structure, even after passing through a melting agency, is retained in the resulting casting. If this is true, the result will be stronger castings without loss of machinability, and should be a factor in enabling the production of castings to meet more adequately the requirements of the modern shop.

There is less physical effort in handling the smaller pig iron, and due to its shape and size, it is adaptable for varying storage conditions. The rounded edges have been favorably commented on by the men handling the iron.

With the use of the smaller pig, foundry managers have found it advisable in case first iron is poured into chills or sand pigs, to regulate the size of their pigged-iron to conform with the smaller size. Also, if it proves necessary to charge heavy pig iron or heavy scrap in addition to the new type of pig, foundrymen have discovered that the heavy sections should be charged first. This is due to the fact that the smaller pig will melt more rapidly and, therefore, the heavier sections must be favored.

In addition to the economies in the use of the new pig already mentioned, such as the reduction in foundry losses and in melting time, there should be some saving in fuel. The new design of pig also has advantages to other melting processes in addition to the cupola.

A.F.A. Nominates Officers and Directors

Nominating committee of the American Foundrymen's association, at a recent meeting held in Cleveland, nominated James L. Wick Jr., president and general manager of the Falcon Bronze Co., Youngstown, O., for the president of the association for the years 1936-37. Mr. Wick at present is vice president of the association, and has long been active in the work of that organization.

In addition to Mr. Wick, the following officers and directors were nominated: Vice president, Hyman Bornstein, chief chemist and metallurgist, Deere & Co., Moline, Ill.

Directors to serve three years include: Marshall Post, vice president, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; L. N. Shannon, vice president and production manager, Stockham Pipe & Fittings Co., Birmingham, Ala.; James R. Allan, assistant manager, Industrial Engineering and Construction department, International Harvester Co., Chicago; C. C. Gibbs, president, National Malleable & Steel Castings Co., Cleveland; and Dan M. Avey, editor, THE FOUNDRY, Cleveland, retiring president of the association.

Provides Laboratory

Chicago Vitreous Enamel Product Co., Cicero, Ill., recently completed an addition to its plant, planned primarily for conducting research and development of new porcelain enamels. The new laboratory was used to introduce a new and practical method for utilizing unusual finishes and variety of colors in porcelain enamels.

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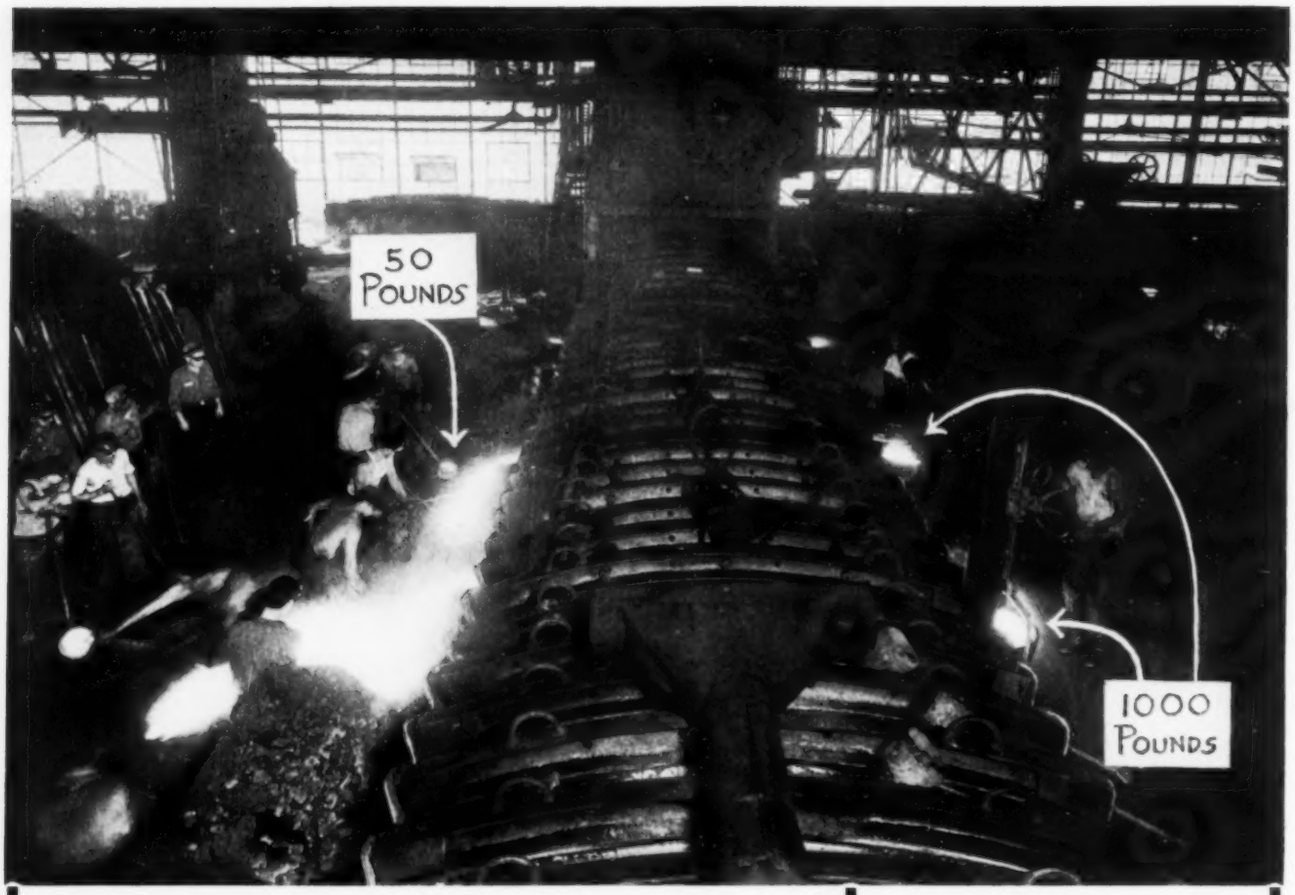

Which side of this furnace resembles your metal handling operations?

The above view shows distinctly how great a saving can be made by eliminating the back-breaking job of carrying the metal by hand. On the right, the metal is tapped off into two *Modern Pouring Devices* with 1000 pound ladles with which one man transports and pours as much metal as 20 hand pourers.

On the left is a crew of hand pourers in the section not yet Modern equipped. Despite the large number of pourers on this side, they take off only a small proportion of the heat.

Sealed Heat

The use of *Modern Covered and Insulated Ladles in Modern Pouring Devices* has enabled handling much larger quantities of metal at a time and pouring much lighter work than here-to-fore. Production is increased, being no longer limited by pouring capacity; labor turnover is reduced.

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Reader's Comment

EDITOR'S NOTE—*Material Appearing Under this Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Sharpening Wits

TO THE EDITORS:

In reading the second installment of the article by H. A. Schwartz entitled "Shrinkage," which appeared in the December issue of THE FOUNDRY, I discovered what appears to be an error in the calculations of footnote 8.

Consider the sentence, "The area marked out by the conical elements extended until they intersect the outer surface of the mold is

$$\frac{R+d}{R}$$

where d is the mold thickness.

Should not the expression

$$\frac{R+d}{R} \text{ be } \frac{(R+d)^2}{R^2}$$

Also on page 50 of the December issue at the top of the second column (Problem 6) it is stated, ". . . accompanying a cooling of 1050 degrees Cent." and further the equation

$20 \times 20 \times 10^{-6} \times 1050 = 420{,}000 \times 10^{-6}$

centimeters. This should read "accompanying a cooling of 1025 degrees" and

$20 \times 20 \times 10^{-6} \times 1025 = 410{,}000 \times 10^{-6}$

centimeters, etc.

Further, in attempting to derive the expression for the mean temperature of a sphere in footnote 14, I arrive at

$$\frac{4\pi}{v}\int_0^R \theta r^2 dr$$

Am I wrong or has the printer substituted a dv for a dr in the article?

I want to thank the author and the editors of THE FOUNDRY for giving us this article, as in a practical magazine such as THE FOUNDRY, we necessarily get very few highly technical problems on which to sharpen our wits.

NEAL F. CLEMENT

Erie Foundry Co.
Rochester, N. Y.

TO THE EDITORS:

The following is offered in connection with Mr. Neal Clement's correction of certain mathematical material in the December installment of Shrinkage:

The writer is indeed grateful to Mr. Clement for pointing out certain errors and discrepancies. The difficulties connected with the accurate publication of any work involving much calculation have become almost proverbial.

Mr. Clement is, of course, correct in pointing out that for the expression

$$\frac{R+d}{R}$$

the square of that function should have been introduced. The omission of this exponent has, of course, vitiated quantitatively everything that follows in the foot-note and the use of these calculations which has been made in plotting Figs. 10 and 11 and so on. The simplest way to remedy this matter for the use of a reader who is interested only in a typical problem is to restate Problem 4 by making the layer of sand 10 centimeters thick (4 inches) instead of 5 centimeters (2 inches). This change is made because if d (not small r, as printed in foot-note 8), is 10 instead of 5, then the expression

$$\frac{2R^2+2Rd+d^2}{2R^2d}$$

has the value 0.25 which is that derived by using the expression

$$\frac{2R+d}{2Rd}$$

in the problem as originally stated. The numerical conclusions and the graphs then remain unaltered.

The other two discrepancies pointed out by Mr. Clement involved in the one case a slip in not deducting room temperature and an error either in transcribing or type setting neither of which was caught when proof reading.

It is urgently hoped that any other readers finding errors will follow Mr. Clement's example in bringing them to attention.

Yours very truly,

H. A. SCHWARTZ
Manager of Research

National Malleable & Steel Castings Co.
Cleveland

Referring Back

TO THE EDITORS:

Upon reading "Yours Received and in Reply" in the January issue of THE FOUNDRY, I could not help but refer back to our correspondence regarding my very mild talk to the foundrymen in Philadelphia and I find your letter to me of October 18th from which I quote as follows:

"After all, Sam, I have some hesitancy in reiterating criticism of existing conditions. Many foundrymen have been kicked around and abused to the point that they are saddle sore and bridle gored to the point of an inferiority complex. Perhaps, this also reflects what you and I may be feeling with regard to the disappointment attending efforts to improve their lot."

Compare this with the following contained in your January, 1936, editorial:

"Only a few out of thousands of foundries are modern, light, clean, orderly and fit for human beings."

"Now we say to you, Mr. Foundryman, your plant is worn out. Your equipment, decrepit or obsolete, is junk. Your methods and thinking are as bad as your plant."

"With tonnage increasing, get more per ton. If you say you can't, quit."

"Have self respect to earn enough to let men live and work like human beings."

Happy New Year!

SAM TOUR

Lucius Pitkin, Inc.
47 Fulton street
New York

Broadcast

TO THE EDITORS:

May I comment on your editorial in the December issue of THE FOUNDRY? I think you are obtaining new heights. Your last one, however, is unusually good and should be circulated and reprinted in all of our trade publications.

I have heard very favorable comments from a number of sources and certainly information of this kind should be broadcast and not bottled up within your own circulating membership.

E. H. BALLARD

General Electric Co.
Schenectady, N. Y.

Thanks a Million

TO THE EDITORS:

A thousand congratulations on your leading editorial in this month's issue of THE FOUNDRY. I am writing the different associations of which we are a member, suggesting that reprints of it be made and sent broadcast to foundries. More power to you.

W. H. WORRILOW
President

Lebanon Steel Foundry
Lebanon, Pa.

Let Light Dawn

TO THE EDITORS:

That certainly is a splendid editorial that appeared in THE FOUNDRY for December, and I compliment you. Sincerely do I trust that the buyers of Fort Pitt Malleable's products and all my other affiliations, will let the words of your own good self, and our friend Tom Girdler, sink deep into their craniums and let the light dawn on the fallacy of their practices.

Unfortunately, it is our experience that just the reverse of the sound policy advocated in "Buyers Who Are Fair Gain" is the order of the day, and to procure even the crumbs of business one has to give the last farthing he may have hoped for, over and above actual costs, and in many cases, costs are not even granted.

Would that many more articles such as appears on page 21 of your paper,

(*Concluded on page* 56)

Shrinkage

by H. A. Schwartz

Fourth Installment

Problem 10.

CALCULATE the length of time the temperature will stand still at the melting point for spheres of the usual size cooling in sand of the previously assumed thickness of each of the three metals if the superheat be such that at the melting point $\frac{\theta}{\theta_o} = 0.9$ and also if it be $\frac{\theta}{\theta_o} = 0.75$, the approximate limits of the common pouring temperature range.

Assuming as usual that the specific heat of the metals is independent of temperature or of the state (liquid or solid)[21], we may calculate the range of temperature for each metal whose traversal will correspond to the same change in heat content as does the change of state during freezing. This will be merely the latent heat of fusion divided by the specific heat. The numerical values for the three metals being considered will be

$$\text{Aluminum } \frac{80}{0.214} = 374 \text{ degrees Cent.}$$

$$\text{Copper } \frac{50}{0.0914} = 547 \text{ degrees Cent.}$$

$$\text{Iron } \frac{69}{0.1055} = 654 \text{ degrees Cent.}$$

The temperature will therefore remain constant at the melting point for that time which would be required for the metal to cool through these temperature intervals if it continued to cool at the same rate at which it is cooling at the melting point.

Consulting Fig. 10 (THE FOUNDRY for December, 1935) we find that at $\frac{\theta}{\theta_o} = 0.9$ the slope of the cooling curves, i.e. the value of $\frac{d\frac{\theta}{\theta_o}}{dt}$ is as follows:

For iron and copper $\frac{0.1}{300} = 0.00033$,

for aluminum $\frac{0.1}{200} = 0.0005$,

At $\frac{\theta}{\theta_o} = 0.75$ these values are:

for iron $\frac{0.1}{400} = 0.00025$,

for copper $\frac{0.1}{350} = 0.00029$,

and for aluminum $\frac{0.1}{300} = 0.00033$.

The melting points of the three metals are:

Aluminum	660 degrees Cent.
Copper	1083 degrees Cent.
Iron	1535 degrees Cent.

so that θ at the melting point being the temperature above room temperature (25 degrees Cent.) will be respectively 635, 1058 and 1510 degrees Cent.

Substituting these values for θ_o in the six values of $\frac{d\frac{\theta}{\theta_o}}{dt}$ calculated previously we have the cooling rate in degrees per second of the three metals at their melting points for the two degrees of superheat set by the problem. Thus for the lower degree of superheat ($\frac{\theta}{\theta_o} = 0.9$ if θ_o be the melting point) we have

For aluminum:

$$\frac{d\frac{\theta}{\theta_o}}{dt} = \frac{d\frac{\theta}{635}}{dt} = \frac{d\,\theta}{635\,dt} = 0.0005$$

$$\frac{d\,\theta}{dt} = 0.3175 \text{ degrees Cent. per second}$$

For Copper:

$$\frac{d\frac{\theta}{\theta_o}}{dt} = \frac{d\frac{\theta}{1058}}{dt} = \frac{d\,\theta}{1058\,dt} = 0.00033$$

$$\frac{d\,\theta}{dt} = 0.3527 \text{ degrees Cent. per second}$$

For iron:

$$\frac{d\frac{\theta}{\theta_o}}{dt} = \frac{d\frac{\theta}{1510}}{dt} = \frac{d\,\theta}{1510\,dt} = 0.00033$$

$$\frac{d\,\theta}{dt} = 0.5033 \text{ degrees Cent. per second}$$

Similarly for the greater superheat $\frac{d\,\theta}{dt}$ is for aluminum 0.2117, for copper 0.3068 and for iron 0.3775 all in degrees Cent. per second. The times of temperature arrest are then the previously computed temperature intervals divided by these quantities which are as follows:

Table II.

	Low Superheat	High Superheat
Aluminum	1178 seconds	1767 seconds
Copper	1550 seconds[22]	1783 seconds
Iron	1299 seconds	1732 seconds

(*Continued on page 52*)

Footnote references will be found at the end of this installment starting on page 55.

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(*Continued from page 50*)

It is evident that the time during which the temperature is constant is considerable, is not greatly dependent on the kind of metal[23] and is increased considerably as the superheat increases. The cooling curves of the spheres plotted in Fig. 10 could then be adapted to the existence of a latent heat of fusion by separating them into two parts at that value of $\frac{\theta}{\theta_o}$ corresponding to the melting point and displacing the lower temperature portion bodily to the right by the temperature intervals given in Table II and drawing a horizontal line at the melting point joining the two portions of the curve.

The horizontal line marks a time interval in which the temperature does not change, during which accidental internal temperature gradients are further wiped out and during which the metal freezes from the outside in. These conditions obviously do not alter the conditions underlying the discussion of shrinkage in sand cooled spheres.

It is fortunate that the foundryman is more often interested in sand molds than in chills for the quantitative application of the principles of cooling in chill molds to the condition of a latent heat of fusion is beyond our ability. We can discuss the matter only from a qualitative standpoint.

The dotted lines of Fig. 24 are the lines of Fig. 20 (both horizontal and vertical scale being doubled). The diagram is for a pouring temperature θ_o such that at the melting point $\frac{\theta}{\theta_o} = 0.75$. Let us now consider, qualitatively only, the changes produced in this diagram by a finite latent heat of fusion instead of a zero value for this constant. First the temperature to which the surface layer (10 centimeters radius) is instantaneously depressed is no longer one-half the pouring temperature but one-half the sum of the pouring temperature and the temperature interval corresponding to the same change in heat content as does the change of state from solid to liquid. The temperature line of the surface metal then begins at say $\frac{\theta}{\theta_o} = 0.65$ instead of at 0.50 as before. The layer of 9 centimeters radius finding the layer beyond it hotter than before will cool to the melting point more slowly and then stand still in temperature for that interval required to dissipate the latent heat of fusion at the existing rate. When this time has elapsed the 9 centimeter radius layer finds the 10 centimeter radius layer colder than it did in Fig. 20 when it crossed the melting point and therefore cools perhaps a little faster than before. It is here that uncertainty enters; we no longer have a perfectly acceptable way of computing the changes in cooling rate which should be used.

The layer of 8 centimeters radius would have its cooling rate especially near the melting point still further reduced for it can not reach the freezing point until the 9 centimeter layer has passed below it. There will then be a horizontal arrest of temperature followed by an accelerated cooling rate. The solid lines of Fig. 24 supply a mere guess at what these time-temperature lines at various distances below the surface may be like.

If now we take the moment when freezing has progressed to a given depth, say 5 centimeters, and irrespective of whether the time is taken as that at which freezing begins or ends, we find that the cooling, and hence the shrinkage rate of the inner liquid layers are much slower and of the outer solid layers at least as fast as in Fig. 20. The net effect is to maintain contact between solid and liquid longer than before and hence to reduce the resulting shrinkage void. How much we can not say unless we learn how to plot accurately instead of diagramatically the lines of Fig. 24.

Most commercial alloys are not pure substance (or even eutectic) and hence do not have a sharp freezing point. They freeze, with evolution of heat over a more or less extended temperature range. Metallurgists have constructed so called constitutional diagrams for practically all important alloys of two metals and for many alloys of three metals. Such diagrams mark out the range of temperature within which the metal is partially liquid and partially solid.

The metallurgist can compute the apparent specific heat within the freezing range[25] and hence one can plot the cooling rate within the freezing range of a metal cooling, say in a sand mold. Instead of the absolute

(*Continued on page 55*)

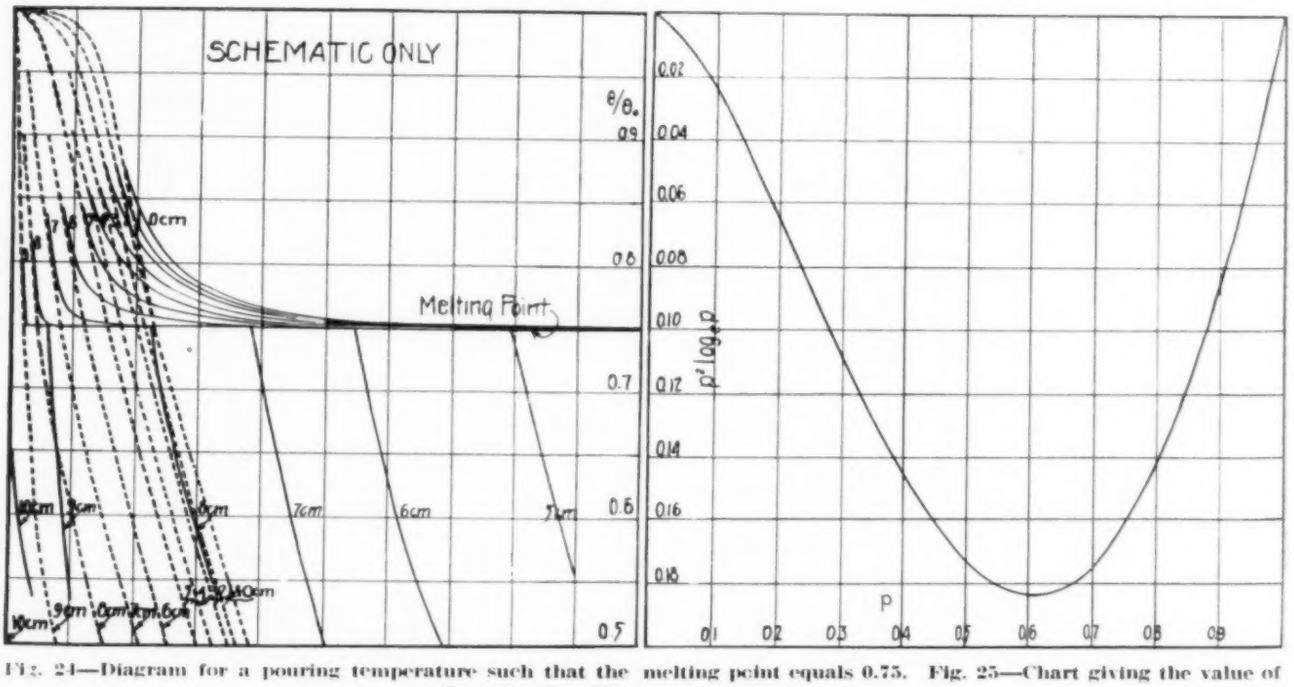

Fig. 24—Diagram for a pouring temperature such that the melting point equals 0.75. Fig. 25—Chart giving the value of the ratio of mold to casting diameter

ADVERTISING PAGES REMOVED

(*Continued from page* 52)

flattening of the cooling curve such as was computed to correspond to the latent heat of fusion of a pure substance, there is a slowing up but not an entire stoppage of cooling during the freezing interval. Having already observed that in the ordinary cases of sand molds even the complete arrest of cooling does not alter the volume of the shrinkage void, it is at once apparent that the lesser slowing up is also without effect. A quantitative treatment of the chill casting problem is even less feasible for the alloys than for the pure metals. When in later problems the cooling curve in sand is required it suffices to take the difference in heat content of the just completely molten and just completely frozen metal and compute the time required to dissipate this at the mean rate of loss between the temperature when the metal is just completely liquid and just completely solid. This amount of time is spent in freezing and the temperature gradient in this interval may well be considered a straight line.[34]

The existence of a freezing range is held by many metallurgists to be conducive to effective feeding by maintaining open passages of liquid metal within the casting until it is completely solid.

Since the formation of a shrinkage cavity is unavoidable, as we have already learned, in any metal which decreases in volume on freezing or in even an ideal metal in which temperature gradients are formed during freezing, it is of importance to the foundryman to devise means for overcoming the difficulty. To do this there must be provided a reservoir of metal in which enough liquid must always be available to make up the volume required to fill the void forming in the casting.

In the case of permanent mold castings these considerations would require a feeder in which the ratio of volume to surface is greater than in the casting. This frequently would mean an entirely disproportionate weight of feeder. In castings of this type the conditions often can be made such that the feeding is accomplished from the gate itself by inflowing metal from the ladle, the casting having nearly frozen before pouring is complete. The ingot mold is a most frequent application of these principles and here the upper part of the ingot freezes last because it contains the last metal poured, because in one type of mold the ingot is larger at the top, and because the mold may be fitted with a hot top, i.e. an extension made of a material of lower diffusivity than the mold proper. In the case of the ingot there is no particular pre-established boundary separating the casting from the feeder but cropping is done in accordance with the location of the void.

For the foundryman's purpose we may well confine ourselves in the future to feeding in sand molds not only because the consideration is much simplified but also because the vast majority of castings are made in such molds. For the purpose of this discussion one need but remember that nothing in what follows concerning feeders is applicable except to sand castings unless the contrary is clearly stated.[34]

For convenience we may consider the principles of feeding to a cylindrical casting standing vertically in a cylindrical mold. If the sand layer be not too thick and heat is assumed to travel only radially outward and not out through the cylinder and mold ends, the time in seconds required to reach the melting point can be shown to be

$$t = -\frac{\theta_o - \theta_f}{\theta_f} \cdot \frac{p^2 R_m^2 \rho c}{2k} \log_e p \quad (36) \quad (2)$$

where p is the ratio of casting radius to mold radius, θ_o the pouring temperature, θ_f the freezing point of the metal, R_m the mold radius, k the conductivity of the mold walls, ρ the density of the metal and c its specific heat. Therefore for a given metal poured at a given temperature and mold diameter the time required for the metal to reach the freezing point is proportional to $p^2 \log_e p$ where p represents the ratio of mold to casting diameter.

It follows logically that if two geometrically similar solids are to act as casting and feeder the feeder would always require to be of such cross section as to make $p^2 \log_e p$ greater than for the casting.

The solution of such an equation is facilitated by the use of the chart shown in Fig. 25 which gives the value of p corresponding to any given value of $p^2 \log_e p$.

Since the mold must be larger than the feeder, p^2 can not be greater than unity. Comparison of the Fig. 25 with equation (2) shows that the time to reach the freezing point (or any other predetermined temperature) from a given pouring temperature is greatest if p is about 0.6.[35] The feeder should thus be of such size (at least) that the value $p^2 \log_e p$ corresponding to its diameter is nearer 0.18 than for the casting. The matter will be explained further in connection with Problem 12.

Alternatively we may arrange to supply hotter metal to the feeder than to the casting, as for example, by pouring up the feeder with hot metal after the casting has cooled so as to make the temperature in the feeder higher than that in the casting at zero time.

(*To Be Continued*)

[33]The reader is reminded that this is merely a simplifying assumption but perhaps as accurate as is necessary to make it as good as the approximation of a shop condition to the basic assumption.

[34]Cooling curves of iron and copper are practically coincident at $\frac{\theta}{\theta_o} = 0.9$ if they could be separated; the copper curve is actually a little steeper than the iron curve and this value would have been lowered.

[35]The diagrams also indicate the composition of the solid and liquid phases and hence the relative amounts for a known alloy composition. If one knows the specific heats (solid and liquid) and latent heat of fusion of the two continuous series of compositions involved it is plainly possible to compute the heat loss of the metal per degree change of temperature within the freezing range.

[34]It, of course, is not a straight line but dependent on the conditions outlined in [33], and also dependent on the change in heat dissipation with temperature. The completeness and accuracy of the rest of our data, however, does not warrant nor does our purpose often require any further refinement.

[35]Although we are about to consider that the shrinkage is determined solely by the change in volume on freezing, we must remember that the diffusivity of cast iron at any rate is not so high as to keep the temperature uniform in a casting of even moderate size. The writer showed—"Shrinkage in White Cast Iron," *Transactions* American Foundrymen's association, Volume 37, page 224, 1929 that shrinkage voids in spheres $2\frac{1}{2}$ inches in diameter was not independent of temperature. This could be true only if gradients exist.

[36]Assume that the outer walls of the mold are maintained at a constant temperature and that all other temperatures are measured above this temperature in degrees Cent. Assume further that the diffusivity of the metal is so great that the cast cylinder shows no measurable temperature gradients.

The heat conducted per unit time through every cylindrical shell of unit height in the sand mold is the same when the steady state exists, and is

$$H = -2\pi r k \frac{d\theta}{dr}$$

where θ is the temperature above the surface temperature of the mold at radius r and k is the conductivity of the sand. The sign is minus for the heat content of the casting decreases when θ decreases with increasing r. Hence,

$$\frac{dr}{r} = -\frac{2\pi k}{H} d\theta$$

and integrating

$$\log_e r = -\frac{2\pi k}{H} \theta + I$$

At the mold surface $r = R_m$ and $\theta = 0$ hence $\log_e R_m = I$

and

$$\log_e r = -\frac{2\pi k}{H} \theta + \log_e R_m$$

At the surface of the casting calling its radius R,

$$\log_e R = -\frac{2\pi k}{H} \theta + \log_e R_m$$

$$\log_e \frac{R}{R_m} = \log_e p = -\frac{2\pi k \theta'}{H} \left(\text{if } \frac{R}{R_m} = p \text{ by definition}\right)$$

where θ' is the temperature of the metal, which may be rewritten

$$H = \frac{2\pi k \theta'}{\log_e p}$$

and the heat lost in time, t, is

$$Q = H\ t = -\frac{2\ \pi\ k\ \theta'}{\log_e\ p}\ t$$

where θ' is a function of t.

Let θ_0 be the value of θ' when $t = 0$

The heat lost in time, t, is also

$Q = (\theta_0 - \theta')\ \pi\ R^2\ \rho\ c$

where $(\theta_0 - \theta')$ is the temperature change in time, t, $\pi\ R^2$ the volume of the casting per unit height, ρ its density and c its specific heat, hence

$$-\frac{2\ \pi\ k\ \theta'}{\log_e\ p}\ t = (\theta_0 - \theta')\ \pi\ R^2\ \rho\ c$$

$$-2\ \pi\ k\ \theta'\ t = (\theta_0 - \theta')\ \pi\ R^2\ \rho c\ \log_e\ p$$

$$t = -\frac{\theta_0 - \theta'}{\theta'}\ R^2\ \frac{\rho c}{2\ k}\ \log_e\ p$$

remembering that $R = p\ R_m$ by definition where R_m is the mold radius, this becomes at the melting point θ_f,

$$t = -\frac{\theta_0 - \theta_f}{\theta_0}\ \frac{p^2\ R_m^2\ \rho c}{2\ k}\ \log_e\ p$$

It is implied in this derivation that the cooling is so slow, i.e. the masses so large that the *steady* state is approximately maintained in the sand layer and that the sand layer is not too thick.

[2]Exact value could be determined by putting the first derivative of $p^2\ \log_e\ p$ equal to zero and solving for p.

Readers Comment

(*Concluded from page* 49)

would be placed prominently in all trade papers in an effort to bring home strongly the policy of "live and let live."

FRANK J. LANAHAN
President
Fort Pitt Malleable Iron Co.
Pittsburgh

For 20 Years

TO THE EDITORS:

Just read your editorial in current issue of THE FOUNDRY. It strikes me that in asking such a question as did your correspondent, viz.: "Should a molder be discharged for having a 10 per cent loss of castings," he betrays the fact that he is unfit to be in a position to discharge anybody.

I am reminded of a remark I overheard a foundry foreman make one time on the occasion of my visit to a stove foundry in Allegheny.

A molder approached us while the foreman and myself were conversing. He was carrying a wabbly, weak, wooden cope. He said to the foreman, "Can't you get me some new flasks for this job. These flasks are not fit to use any more." The foreman answered, "Well I'll be damned. Them flasks have been used on that job for 20 years and you're the first man ever kicked about them."

So, I say *more power* to *you*.

BEN D. FULLER
Lakewood, O.

Tile Gates

TO THE EDITORS:

Looking back over 49 years in the foundry I have wondered why some foundry supply house does not handle sewer pipes for gates in sizes say from 1½ to 2½ inches diameter. About 35 years ago I saw this type of gate while working for the Wm. Todd Co., Youngstown, O. Two engines were built for the Republic Iron & Steel Co., with a plant almost next door. William Knowles, a highly competent man was superintendent of the foundry. Bed plates for the engines weighed approximately 147 tons. This large quantity of metal was poured through sewer pipe gates.

Often I have seen down gates break through especially where the sprue extended to a gate at the bottom of the mold. In deep copes, either green or dry sand, if the molder misses a ramming around the sprue, that area is soft and will crumble. The metal cuts the sand away in that area and washes it into the mold. In a typical instance where incidentally the molder was fired, a deep pattern was molded in green sand and gated at the bottom. The drag was rolled over and was made up of two flask drag sections and three or four frames or upsets. The upsets had been used often before and were burned to such an extent that you could stick your fingers through them in some places.

By the time the metal appeared in the cope, the pressure was sufficient to drive it through the upsets back of the sprue. Three days work for a molder and coremaker all shot. Certainly that would not have happened if Bill Knowles had been boss, or if the molder had used a tile or sewer pipe for the down sprue. Also there would have been no need to place any rods between the sprue and the pattern. Metal flowing down a sewer pipe is clean. It does not wash blacking or other foreign material into the mold. I am not advocating the use of sewer pipe gates on chicken feed and ding-a-ling stuff. For large castings this type of fool proof gate should be used. In navy yards and in plants making castings subjected to a water pressure test, this type of gate will prevent entrance of blacking, etc., which remains in the casting and allows the sweat to ooze through. I don't know if sewer pipes are made in small sizes, but I think there is a wide field for their application in the foundry.

THOMAS GALLERY
23 *Chester Street*
Groton, Conn.

Appointed Representative

Consulting Engineering Co., No. 1 Terminal Office building, Carson street, Pittsburgh, has been appointed representative of the Pennsylvania Pump & Compressor Co., Easton, Pa. in the Pittsburgh district. The Consulting Engineering Co. is managed by J. F. Tutein and T. G. McCann.

Industry Leader Deplores Credit Restrictions

"Debasing the Currency," a pamphlet by E. S. Pillsbury, president, Century Electric Co., St. Louis, Mo., seeks to explain by pointing to the Federal Reserve Act of 1913, the charted lag in industrial production and building activities in the United States as compared with other nations, the irregular return of prices to normal after the world war and the regular return after the civil war, and the unsatisfactory adjustment of wage rates. The commodity price collapse of 1920, the bull market collapse of 1929 and the 41 per cent cut in gold backing of the dollar, Mr. Pillsbury would trace to the act.

The author contends that by permitting a small group to determine the extension of credit, any desired amount of capital is made available without the beneficial limitations exerted on the price level in the open market by supply and demand. If the Federal Reserve board is allowed to continue as a price manipulating body for money, Mr. Pillsbury believes a new decline following a period of perhaps eight years of prosperity is inevitable.

The 1816 maxim of Ricardo, reiterated in the booklet, is a summation of this 24-page discussion: "If the State is to prosper, money must be anchored to a stable standard and the money supply must be controlled by the automatic processes of trade and not by the dictates of a government." "Government" in this instance is a "group with authority to utilize government credit and constituting a bank of issue."

Yearbook Gives Information on Minerals

Minerals Yearbook, 1935, compiled by O. E. Kiessling, chief economist, minerals resources and economics division, recently was published by the United States department of interior, bureau of mines. The work is divided into four parts, part 1 providing a survey of the mineral industries, part 2 dealing with metals, part 3 with nonmetals and part 4 with mine safety.

The book, which includes 1293 pages of data may be obtained from the superintendent of documents, Washington, D. C. for $2.00.

MOLY increases the pay load by decreasing the dead load

FREIGHT haulage is the railroad's "bread and butter." One way to lower operating costs is through lighter, yet stronger, load-carrying rolling stock. It permits larger pay loads per car or more cars per train: less strain (particularly in starting) and less fuel consumption.

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"A little Moly does a lot," therefore Moly steels cost less than other alloy steels having equivalent properties for a given purpose. They cost but slightly more at first than plain carbon steels, and cost much less in the long run.

That is not the whole story by any means. Moly steels reduce wear, breakage, and destruction from corrosion. Consequently, maintenance and depreciation costs are reduced. Summed up, Moly steels will make a notable reduction in over-all operating costs, on a train-mile or any other basis.

Innumerable instances prove Moly's worth. Our book, "Molybdenum," gives valuable technical data. Yours for the asking — as is also "The Moly Matrix," our periodical news-sheet. Climax Molybdenum Company, 500 Fifth Avenue, New York.

CUTS COSTS CLIMAX Mo-lyb-den-um CREATES SALES

The end of a perfect day

The Adventures of BILL

By PAT DWYER

BILL came stamping in the other night enveloped in a huge fur coat. He shed the coat and drew a chair up to the open fire in front of which I was enjoying a peaceful drag or two from an old cob pipe. To a comment from another member of the party Bill brazenly stated that the coat was the skin of a polar bear shot by his uncle Dan while that intrepid gentleman was accompanying the late Admiral Peary on his dash to the North pole. The coat had been worn by his uncle for 30 odd years and was known by sight and smell to every one in the uncle's native town. Finally when the time came to slip his moorings for the last time and take his departure for the haven under the hill, he had bequeathed the coat to his favorite nephew William. "He was a fine looking figure of a man," Bill remarked complacently, "An' he knew the coat would just fit me."

As a plain matter of fact I know that he came into possession of the coat a few years ago by lending a lad who was hard up the munificent sum of $10.00. The lad pledged the coat as security. Unfortunately he was addicted to the immoderate use of strong waters. Filled to the gills one night he strolled down to the dock and when he was dragged up on the end of a grappling hook several hours later he had no further use for the coat.

Bill never tells this version, but on the other hand he tells any one of forty different versions whenever any person questions him on the subject. In one he raised the bear from a cub, but had to do away with him when he started following him into the shop and tramping over open sand molds. In another armed only with a knife he had killed the bear in a terrific hand to hand struggle on the slope of Mt. Shasta. Now and again he falls back on the story that he actually bought the coat one winter in Montreal while he was working in the steel foundry out at Longue Pointe. In still another version he won the coat in a poker game where he toiled with fluctuating measure of success from sunset one day to sunrise on the following morning. He dwells with great detail on the hands held by the various contestants at various stages of the game, indicates that at more than one time he was stripped practically naked, but by a miraculous streak of luck, reinforced by the exercise of truly remarkable technical skill, he finally acquired practically all the goods and chattels of his opponents, including three fur coats. Later he had sold two to a couple of lads who were taking part in the great dog Derby, but the third, and best he had retained for his own use.

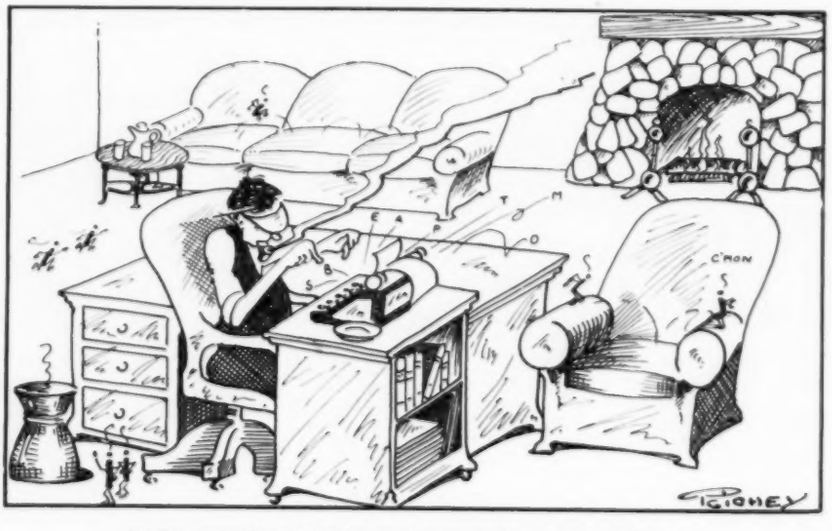
In the present instance I ventured to comment on this deplorable habit of handing out false information.

"Well," said Bill, "I'll tell you. I don't see that it is any person's business where I got the coat. That fact in itself would be sufficient reason for returning what is known in the higher circles of society as a diplomatic answer. In the lower circles it is known as shooting the bull, a sport by the way at which the newspaper boys are particularly adept. For example I have in mind a series of sketches which ran daily for a couple of weeks before Christmas in one of the city papers. These purported to be actual case histories of indigent individuals cruelly buffeted by fate, and apparently were designed to loose the tear ducts and the purse strings of the reader. Every person knows that misery and privation exist in this and in every other city. With comparatively little trouble any reporter could get the actual facts in any number of cases. However, apparently the reporter in this instance instead of going out to get the facts, preferred to sit in a nice comfortable office and draw on his imagination."

"I read the stories," I said, "and I thought they were very nicely written. They would wring tears from the heart of a graven image."

"Well," said Bill, "the first two or three bearing every evidence of authenticity, almost had me blubbering.

(*Concluded on page* 60)



In his squalid attic the scribe weeps for the under dog

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STERLING ABRASIVES

(*Concluded from page* 58)

Then I read one which caused me to lose all further interest. Jim Malone, with an invalid wife and three emaciated children had not worked for 2 years. Jim, a brawny bessemer worker, with bulging muscles, thickly corded neck, arched and hairy chest was a fine example of the sturdy race of men who have given this country her supremacy as a great steel producing nation. His thick hands were calloused from manipulating the rolls. His eyes were half closed from watching the hellish brew in the immense caldron and the skin on his face was wrinkled and scorched almost black from the fiery atmosphere of the furnace. In a general way I gathered the general impression that Jim was more or less a burnt offering, a sacrifice on the altar of steel.

"After loafing for 2 years Jim tramped 2 miles to the steel works gate one morning and hung around all day until the foreman came out at night. The foreman, impressed by Jim's physique, said he would be glad to put him on. He told him to come around next day and see the employment manager. Next day the employment manager told him he did not need any men, at present, but if Jim could get a recommendation from a former employer, why he would be glad to place his name on the waiting list. Jim wrote to his former employer in a distant city and waited vainly several weeks for an answer. Finally in desperation he tramped and hitch hiked his way to a town almost 500 miles away and upon personal application was given the letter of recommendation. He tramped and thumbed his way back and presented the letter. The employment manager read it and told Jim he would keep him in mind if anything turned up. That was six months ago and Jim has heard nothing yet."

"What's wrong with that story? Outside the calloused hands, the bulging muscles and the scorched skin of a man idle for 2 years—a little local color thrown in for effect by a nontechnical writer—the story sounds authentic enough to me."

"What's wrong with the story? Just one trifling little fact that the writer overlooked. The plant at which Jim is supposed to have applied for a job, has not operated a bessemer department for the past 5 years. The plant to which he tramped and thumbed his way in search of a recommendation that would establish his reputation as a bessemer operator, has not now, and what is more to the point, never had a bessemer department!"

"Seems to me," I admitted sadly, "the world has not improved any since old brother Diogenes went around with a lantern looking for an honest man.

"Well, sir," said Bill, "Believe it or not, I came across a piece in a paper the other day written by an editor who cast all inhibitions and conventions to the winds and wrote the truth exactly as he saw it. Over a period of years he had become soured over the manner in which weddings were reported. Finally on a special occasion he dipped the old quill in a vinegar bottle and wrote the story to please himself.

After giving the names of the bride and groom the editor continued:

The groom is a very popular and successful young bum, entirely lacking in brains and/or ambition, but endowed with a certain amount of low animal cunning which has enabled him to exist without doing a lick of work

Well, they say love is blind

since he was plucked in his junior, or maybe it was his freshman year at college. He manages to dress well, play the ukelele, lounge around night clubs, and fancies he is an absolute authority on such important subjects as wine, women and song. He groups them all under two heads, swell and lousy.

The bride is a slinky, skinny, pigeon toed, fast little idiot with the mental equipment of a fairly young chimpanzee, the settled conviction that every man thinks she is WONDERFUL and that every woman is just dying of envy, and that Helen of Troy, Cleopatra, and other hi-de-ho ladies would suffer grievously by comparison if living today.

She lays the paint on her pitiful little map with all the ardor, abandon and lack of harmony displayed by the one time noble red man preparing for the ceremonial war dance. Her nails are stained a brilliant crimson. Inside of the thumb and first finger are stained with nicotine, and the way she can suck a cigaret and blow the smoke through her nostrils, my dear, is simply nobody's business. She laps up liquor, any kind of liquor as a cat laps up cream with the single exception that a cat has a limited capacity and knows enough to stop now and again. What she does not know about housekeeping or any other useful accomplishments would fill a real hefty book. In a word and without putting too fine a point upon it she's the nuts.

She loves to drive her father's car especially at night when she gets a perfect thrill by ramming lamp posts and hydrants and tearing fenders off by trying to pass large, heavy trucks on narrow roads, or in beating any one and every one at the street intersections. The garage repair man at the corner thinks she is one swell kid. On more than one occasion this honest artizan has been heard to remark enthusiastically that what this country needs is "A flock o' skirts like her, as handy in a car as a bull in a china shop."

The house was newly plastered for the wedding and the exterior was newly painted, thus appropriately carrying out the general decorative scheme, since the groom was newly plastered and the bride was newly painted, white with scarlet trimmings. Among the spectators ye scribe noted the florist and Madame from Ye Bon Ton Ladies Emporium valiantly hoping for the best, which in this instance probably means $5 on account three months from date. Incurable optimists, say we.

The groom wore a rented dinner suit over athletic underwear of imitation silk. A neat and rather recherche effect was achieved by a narrow gap between the vest and the pants which exposed an area of shirt front and the extremities of the galluses, real imitation leather daintily hemstitched around the button holes. Pants nicely bagged at the knees, terminated in a pair of cuffs which tightly hugged the ankles and led us to wonder how any human being could shove a pair of No. 11 feet through such small openings. Perhaps he pulled the pants on over his head. In marked contrast, the coat billowed over his form after the manner of a Roman toga which simply hits the high spots and is held in place mostly by gravity.

Genuine imported patent leather shoes, de luxe model, special price this week only $2.99 at The Bootery, corner 6th and Elm (Adv.) matched the groom's state of tightness and harmonized perfectly with the coiffure, cut in a perfect circle and held in place with a heavy application of some repellant form of googum, slick and smooth as a toboggan slide. Accessory equipment carried by the groom included a pack of cigarets, a dainty pocket knife and nail file on a chain, a bunch of keys, several please remit letters and his usual look of imbecility.

The pair of turtle doves, ha, ha, will make their home with the bride's parents, which simply is another way of saying they will sponge on the old man until he dies, then she will take in washing.

P. S., by the editor—This may be the last issue of my paper, but it represents the culmination of a life long ambition to write up one wedding and tell the truth. Now that this humble ambition has been gratified, death can have no sting.

ADVERTISING PAGES REMOVED

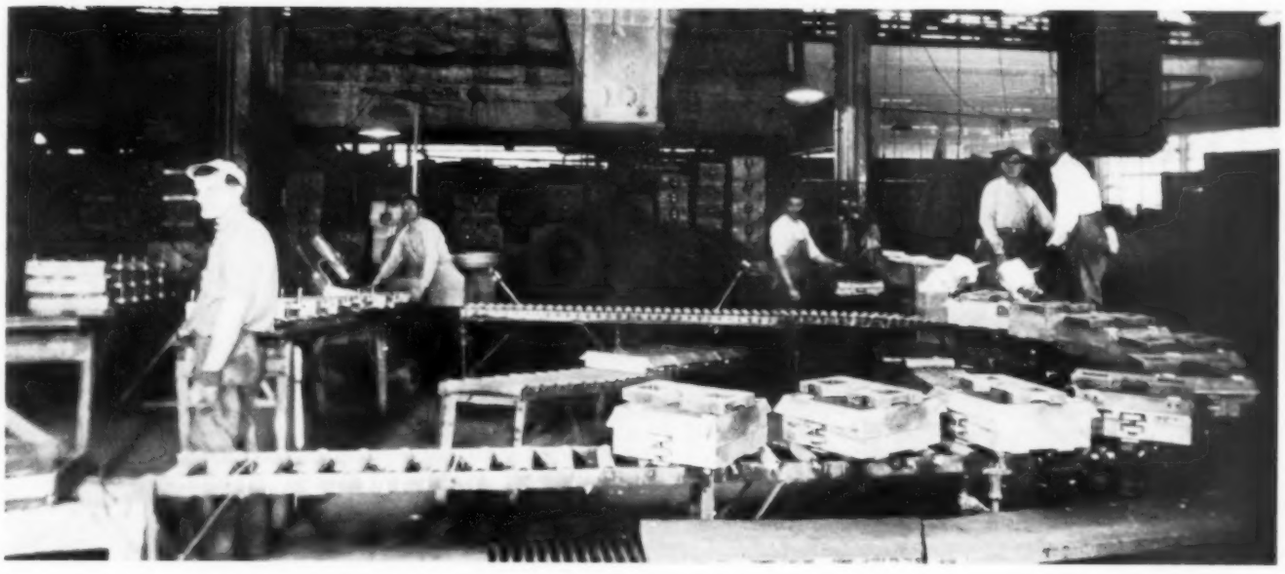

Fig. 8—Continuous pouring aids in the production of small aluminum castings

Progress in Casting Aluminum

(*Continued from page* 24)

Certain of the more specific requirements for casting aluminum should be mentioned. Although not generally known, many of these seemingly minor things are the cause of a majority of the difficulties found in the production of aluminum alloy castings.

Suitable sand is one of the first requirements overlooked in many foundries. Permeability, cohesiveness and durability are some of the properties of molding-sand which determine its usefulness. In addition sand for aluminum castings should have a fine texture to insure satisfactory casting surfaces; should be free of volatile impurities which tend to produce gas in the mold and cause porosity in the casting; and should be capable of being worked with a minimum of moisture. To have these requirements alone is not sufficient unless suitable means of control are provided and used.

The most satisfactory molding sand for the majority of aluminum alloy castings is one which meets American Foundrymen's association 1G to 2G requirements. Such a sand has a natural clay content of 20 to 30 per cent, possesses a grain fineness of from 200 to 250, a permeability of 4 to 8, and a compressive strength, when tempered with 6 to 7 per cent water, of 7 to 9 pounds per square inch. Care should be taken to prevent hard ramming of the sand or excess moisture, either of which reduces the mold permeability and prevents the escape of mold gases. Excess moisture also may produce more gas than can be removed satisfactorily through the sand and thus cause gas blows and porosity.

Dry sand cores, for the same reasons, require adequate control of permeability and binder content. Core binders produce gas which must also be vented from the mold. The natural permeability of the core itself must, in many cases, be augmented by suitable vents. Selection of binders and well-controlled baking will reduce the trouble of excess core gas.

Fig. 9—Metal for medium sized castings is melted in tilting furnaces and transferred to a pouring crucible

Various Core Binders

Cores for aluminum castings may be made from any suitable lake or bank sand if it meets permeability and surface finish requirements. A silica sand with a fineness of from 70 to 90 is satisfactory for most cores. Core oils with a linseed oil base are used much for ordinary work, and synthetic resin binders, pitch and core compounds are used for some castings. The sand-binder ratio is important to secure core strength, as cores which are too strong to be crushed easily by the casting as it contracts are undesirable. Cores that are too hard, particularly if surrounded by metal, invariably result in cracked castings.

Many foundrymen producing aluminum alloy castings either fail to realize the importance of gating in overcoming many of their casting difficulties or consider unwarranted

the additional expense of modifying their iron and brass practice. Unfortunately, no single gating procedure can be applied with equally good results for all types of castings. The technique of proper gating is a foundry art developed principally through experience. There are, of course, certain general fundamental considerations which can be designated.

When deciding on how the gates should be placed for an aluminum alloy casting, there are several factors to consider. First, how can the metal be introduced into the mold cavity to insure the most rapid, uniform and progressive solidfication from the points farthest from the gates to the gated areas? This involves consideration of metal temperature and section thickness. Rapid solidification can be insured by using as low a pouring temperature as possible. Multiple or continuous gates rather than a single gate, and in the case of larger castings, pouring through two or more sprues, permit reduced metal temperatures and also aid in the more rapid filling of the mold cavity.

Gate in Thin Section

Uniform and progressive solidification can be promoted by introducing the coolest metal into the sections which will solidify the most slowly. Gates provided with suitable fillets therefore generally are cut into the thin sections of a casting rather than into the heavy ribs or bosses. Risers or feeders on the gates just adjacent to where they enter the casting, will insure hot metal to take care of any shrinkage or draws caused by the gate proper.

A second consideration when gating a casting concerns the design of the gates. These should be designed and laid out in such a way as to minimize agitation of the metal while pouring and act as skimmers to remove any oxide or inclusions that may be carried into the sprue. This consideration is of great importance for certain alloys, such as those containing magnesium, because of their greater tendency to form oxide during handling. In some cases, skimmer cores similar to those used for other metals have proved satisfactory for aluminum. Control of the relation between the areas of the gates and runners and the area of sprues is always an important factor. The total gate area should be preferably slightly less than the area of the runner, as well as the sprue, to provide skimming action. Runners cut in the cope and gates in the drag aid in securing clean metal in the casting. Pouring basins at the top of the sprues, and in some cases rectangular sprues, are further aids to eliminating dross inclusions by reducing metal agitation during pouring.

Many foundrymen dislike to use adequate risers when gating aluminum alloy castings. The characteristic high crystallization shrinkage of aluminum and the difficulty encountered in ridding the metal of oxide require the generous use of risers, if castings of maximum soundness are to be produced. The proper use of risers requires a knowledge of their functions as exists for mold gases and oxides, reservoirs of liquid metal to feed the casting as it solidifies, and metal temperature gradient controls for reducing casting strains and cracks.

The placing of risers, as the placing of gates, is a problem which must be considered for each particular casting. However, certain general rules should be followed for best results. Risers are attached generally to the heavy sections of castings to provide the necessary metal to those sections during solidification. They should be placed so as to aid, rather than interfere, with the progressive solidification to the points of metal supply. A little study of each casting will indicate the most logical points for adding risers which will meet these requirements.

Risers should be tapered well from the top and be provided with generous fillets at the places where they meet the casting. They should be no larger than necessary to insure their not solidifying before the sections they feed. Too large risers retard the rate of solidification, causing areas of local weakness and in some cases cracks in the castings. The riser height will depend on the size of the casting. Increasing the height will increase the metal pressure, an important requirement for some castings which are difficult to feed. On large castings, risers of rectangular cross-section are preferred, placed with their long axis parallel to the direction of maximum casting shrinkage. This will reduce the resistance of the sand while the casting is contracting in the mold.

Recommend Use of Chills

It is often necessary in the case of aluminum alloy sand castings to chill the heavy sections so as to hasten the solidification of certain parts of a casting. External metal chills of aluminum, copper, or iron may be used for this purpose. Standard chills, in the form of flat disks about 1-inch in diameter and of various thicknesses, are satisfactory for flat surfaces. Form chills prepared from plaster casts are preferred for irregular surfaces. Large chills should be provided with vent holes to prevent blows and such prongs or nails as are necessary to hold them in the mold.

The amount of chill and the areas to be chilled must be determined by trial and experience. Over-chilling is often more harmful to the struc-

(Continued on page 66)

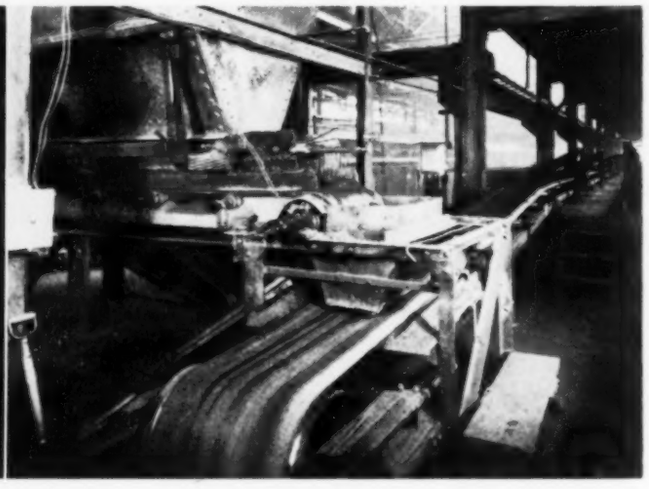

Fig. 10—Cores for aluminum alloy castings, placed on portable racks, are baked at carefully controlled temperatures.
Fig. 11—The tempered molding sand is distributed from the conveyor belt to hoppers above the molding floor

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(*Continued from page* 64)

ture of casting than no chilling, particularly if it interferes with feeding and progressive solidification. Chills are important to control pinhole porosity in heavy sections of a casting.

There are several types of furnaces used for melting aluminum alloys for foundry use. Of these, the indirect flame furnace in which the flame does not impinge on the metal is preferred to direct flame or reverberatory furnaces. The indirect flame furnaces are stationary or tilting-pot types, with capacities from 50 pounds to more than 500 pounds of metal. Such furnaces, from the standpoint of control, are heated preferably with electricity, gas or fuel oil, the gas or oil being the most common. The use of coke is satisfactory, providing adequate temperature control is exercised.

Pit-type crucible furnaces, such as commonly are used for melting brass, should be equipped with covered crucibles when used for aluminum alloys. The reverberatory furnace is used principally for making alloys, as its ability to melt large quantities of metal is a distinct advantage for producing ingot of uniform composition and casting characteristics.

Iron pots, graphite or carborundum crucibles are used for melting aluminum alloys. When iron pots are used, they must be cared for properly to avoid contamination of the metal with iron. A coating of foundry whiting or "red mud," the latter a by-product of the refining of aluminum ore, may be used for this purpose. Such materials are mixed with water to a light paste and applied with brushes to the warm pots. The temperature of the pots should be such that the coating dries immediately without cracking or flaking. Pots should be scraped clean of any adhering metal and recoated at least once a day if used continuously. Crucibles should be cleaned thoroughly inside at intervals to remove any adhering scale.

The chemical composition limits of aluminum alloys are maintained to provide certain physical and casting characteristics. To change the composition by the addition of foreign elements during melting and handling, may destroy some property of the metal or change it, and may cause subsequent foundry difficulties. In foundries handling several ferrous and nonferrous alloys, the mixing of foundry scrap and the use of melting and pouring equipment previously used for other metals, without intermediate cleaning, must be avoided. A system of foundry scrap segregation and, where possible, separate melting pots and pouring ladles, will eliminate trouble from this source.

In neither the solid nor liquid condition do aluminum alloys show their temperature by sharp color changes. Therefore, it is not possible to accurately judge the temperature of molten aluminum by its color, as in the case of certain other metals. The measurement of aluminum temperatures requires the use of suitable pyrometric equipment, preferably of the thermoelectric type. Such equipment consists of an open- or closed-end thermocouple, suitable compensating leads, and a millivoltmeter calibrated to record the temperature. Portable equipment capable of being moved from furnace to furnace, or stationary equipment with several thermocouples and a selector switch, is available for foundry temperature control.

The control of melting and pouring temperature, as well as the metal holding time, is one of the most important factors in the casting of aluminum. The effect of these variables on the structure and soundness of castings and on the casting characteristics of aluminum alloys cannot be over-emphasized. It is a well-established fact that aluminum alloys absorb gases and oxides more readily, the higher the melting temperature and the longer the time at a high temperature. In addition, the grain size of castings increases with both the melting and pouring temperatures, and excessive temperature results in an undesirable grain structure. Certain characteristics of the metal, particularly those affecting the shrinkage, are adversely affected by high temperatures, and excessive surface shrinkage and porosity may

(*Concluded on page* 69)

Fig. 12—Risers that cannot be removed conveniently by sawing are chipped off

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(*Concluded from page* 66)

result. Therefore, aluminum castings should be poured at the lowest possible temperature at which there is sufficient fluidity to fill the mold cavity and still allow air bubbles, gas and dross to escape from the metal before it solidifies. The melting temperature should be no higher than necessary to compensate for the natural drop in temperature between the melting furnace and the mold. The selection of these temperature limits must be determined by trial and experience for each particular casting pattern. Temperatures of 1450 to 1500 degrees Fahr. are considered high for most aluminum alloy castings. Castings requiring temperatures this high should be regated whenever possible, to permit lower pouring temperatures.

The use of fluxes or special metal treatments, in conjunction with proper melting control and foundry technique, is sometimes advantageous in increasing the soundness of certain castings. Such treatments must be carried out under controlled conditions or they may prove more harmful than beneficial. In no case can they be considered as foundry *cure alls*, since failure to control many of the factors mentioned previously may produce conditions which no metal treatment can cure.

With few exceptions, notably the aluminum-magnesium alloys, no flux should be needed when melting previously alloyed ingot. When melting down skimmings or dirty scrap, a flux is usually beneficial in removing the excess oxide and dross. A number of commercial fluxes suitable for this purpose are available; they consist, generally, of metallic chlorides, fluorides and sulphates. Such fluxes must be kept dry or heated thoroughly to drive off any moisture before they are used. Chlorine gas has also been used extensively as a flux but requires suitable hoods or other methods of exhausting the poisonous gas. Double remelting of the metal, with an intermediate slow solidification in the melting furnace, possesses certain merits as a means of freeing the metal of any absorbed gas.

Stir Under the Surface

Molten aluminum should be subject to as little agitation as possible if oxidation losses are to be kept at a minimum. If necessary to stir the metal at any time, this should be done from under the surface, breaking the surface as little as possible. When transferring metal from one furnace to another or to pouring ladles, turbulence can be avoided by keeping the height of drop as small as possible and the stream of metal unbroken. In certain cases, funnels which extend to the bottom of the pot or ladle are used when filling these with metal. Similar precautions should be taken when pouring castings. Many of the common defects in castings can be traced to an excessive pouring height, breaks in the metal stream, or failure to keep the sprue filled while pouring.

The trimming and cleaning of aluminum alloy castings differ little from the practice used for castings of other metals, except possibly in the ease with which it is accomplished. Aluminum alloy castings may be trimmed readily with band saws if the gates and risers are located on outside edges or faces. Inaccessible points must be reached with pneumatic chisels, grinders, or files. Considerable economy can be effected in trimming and cleaning costs if these factors are taken into account while placing gates and risers. Sand blasting is an effective method of cleaning and producing a uniform surface appearance on rough castings.

New England Group Elects Officers

Annual meeting of the New England Foundrymen's association was held at the Engineers club, Boston, Wednesday, Jan. 8. The following officers were elected: President, A. S. Wright, Hunt-Spiller Mfg. Corp., Boston; vice president, Walter M. Saunders Jr., Providence, R.I.; treasurer, Arthur W. Gibby East Boston Mass.; and secretary, Ernest F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass. The executive committee is as follows: Thomas Curtin, Waltham Foundry Co., Waltham, Mass.; Henry Jensen, General Electric Co., Lynn, Mass.; Robert J. Nelson, Arcade Malleable Iron Co., Worcester Mass.; Francis LeBaron, E. L. LeBaron Foundry Co., Brockton, Mass.; and Charles A. Reed, Rogers-Brown-Lavino Co., Cambridge, Mas.

Job Goostray, Hunt-Spiller Mfg. Corp., retired, who has been connected with the foundry industry for 74 years, and who recently celebrated his eighty-fifth birthday, spoke briefly, as did James McLean, Barbour-Stockwell Co., who had been connected with that company for 50 years.

Special entertainment features followed the dinner.

Book Review

The Metal-Iron, by H. E. Cleaves and J. G. Thompson, cloth, 574 pages, published for the Engineering Foundation by McGraw-Hill Book Co. Inc., New York and supplied by THE FOUNDRY, Cleveland, for $6.00 plus 15 cents postage, and in Europe by the Penton Publishing Co. Ltd., London.

This is the sixth monograph of the Alloys of Iron Research; previous monographs having been as follows: *The Alloys of Iron and Molybdenum*, by J. L. Gregg; *The Alloys of Iron and Silicon*, by Earl S. Greiner, J. S. Marsh and Bradley Stoughton; *The Alloys of Iron and Tungsten*, by J. L. Gregg; *The Alloys of Iron and Copper*, by J. L. Gregg and B. N. Daniloff; *Principles of Phase Diagrams*, by J. S. Marsh. The preparation of the monograph, *The Metal-Iron*, was undertaken at the national bureau of standards as a contribution by the bureau to the research.

This monograph is divided into two parts, the first part being devoted to a study of high-purity iron. This includes the discussion of the laboratory production of electrolytic iron, the commercial production of electrolytic iron and chemical methods for preparing high purity iron.

The second part deals with the properties of high purity iron. The discussion includes data on structure, thermal properties, electric properties, magnetic properties, miscellaneous properties, chemical properties, mechanical properties, heat treatment and aging, effect of minor constituents.

The appendix contains a condensed summary of the properties of iron, a bibliography, name index and subject index.

Malleable Firm Installs Shower Room

Malleable Iron Fittings Co., Branford, Conn., recently has installed a modern combination wash and shower room, locker room, clothes drying room and hot water heating plant to accommodate 160 men employed in the malleable and brass foundries. The new facilities are located in a building, next to the fittings foundry, which had outgrown its usefulness as a manufacturing plant. Full standard-sized lockers, 15 inches wide, 18 inches deep and 72 inches high are provided in a room heated by two fan-type unit heaters. The shower room is equipped with seven shower stalls and two 54-inch diameter industrial wash fountains. An adjacent room houses the clothes drying equipment. The hot water heating equipment includes an insulated storage tank having 1000 gallons capacity.

Through a careful calculation of meter measurements, the company has learned that the equipment consumes 10 gallons of No. 2 oil per day, heats 1000 gallons of water from 62 degrees Fahr. to 110 degrees Fahr. for 28 cents, and uses 800 watts of electric power for the burner motor each day.

Bethlehem Steel Co., Bethlehem, Pa., recently was elected to membership in the Association of National Advertisers. John C. Long represents the company in the A. N. A.

Ford Casts Alloy Iron and Steel

(*Concluded from page* 27)

line between iron and steel. Successful application of these metals for specific castings involves subsequent heat treatment to bring out their full possibilities. Varying analyses of the metal in these castings are shown in the accompanying table.

Cylinder blocks are cast from a mixture of cupola and direct metal. Metal for the camshafts is melted in the cupola. Metal for the other castings is melted in a battery of electric furnaces ranging in capacity from 250 pounds to 15 tons per charge. Four 15-ton electric furnaces supply over 400 tons per 16-hour day for the daily output of approximately 8000 crankshafts. The castings in groups of four are cast in a vertical position in a mold built up of 16 individual dry sand cores. Each casting weighs 80 pounds or a total of 320 pounds for the group of four. A heavy central feeding sprue and an individual riser on each casting increase the gross weight of metal in each mold to 420 pounds. Detailed description of the manufacture of these castings was published in THE FOUNDRY for August, 1935.

Close Cupola Control

Close control of cupola operation including the make up of the charge is required in the production of metal for the camshafts. The same degree of accuracy is observed in making and pouring the molds. The analyses of the metal is nicely adjusted to produce a slight chill or white surface on the casting while the interior or core of the casting is gray. The degree of accuracy attained in the production of the castings is indicated by the fact that the only machine finish they receive is a surface grinding on the working faces. Brinell hardness on these faces is held at 418 minimum.

The metal from the furnace is tapped into a 1000-pound ladle and a test bar is poured from each batch. The bar is cooled and broken and from the appearance of the fracture the attendant in charge decides whether the metal is suitable for the intended purpose, or if the composition has to be adjusted slightly by small ladle additions of ferrosilicon or ferromanganese. Usually no adjustment is necessary.

Molds for the camshafts are made from split patterns, with the halves mounted on individual plates as shown in Figs. 1 and 2. The plates in turn are mounted on a battery of jolt-squeeze machines arranged in pairs, one for the drag and one for the cope. Each mold contains two castings connected by gates right in Fig. 1 and left in Fig. 2 which deliver the metal through shrink bobs at one end in the cope, Fig. 2. These gates are fed by a runner from the central sprue. A somewhat smaller gate at the opposite end of each casting is connected to a single large riser located midway, shown right in Fig. 2. The molds are placed on a moving conveyor and the metal is poured while the molds are in transit a short distance from the molding machines. The castings are shaken out almost immediately after they have solidified and the oval conveyor returns the flasks to the vicinity of the molding machines. This routine is standard and applies to practically all castings made in this foundry. With this arrangement a comparatively small number of flasks serves throughout the day.

Valve seat insert rings Fig. 3 are made from a high speed tool steel of the following analysis: Carbon 1.20-1.40 per cent, sulphur and phosphorus 0.05 per cent, copper 1.50-2.00 per cent, silicon 0.30-0.60 per cent, tungsten—14-17 per cent, chromium—2.50-3.50 per cent. Patterns are arranged 36 on a plate and are molded in shallow flasks. The cope is molded on flat plate Fig. 4. The flasks are stacked three high and a total of 108 rings are poured from a central sprue. On an 8-hour shift the production is 700 stacks, a total of 75,600 individual rings.

Valve stems are molded from split patterns, mounted on flat plates in two opposing rows and gated in the ends from a long runner in the center. These molds are not stacked. Electrically melted steel for these castings contains: Carbon 0.95-1.20 per cent, silicon 2.00-3.50 per cent, sulphur and phosphorus 0.05 per cent maximum, nickel 13-15 per cent and chromium 14-16 per cent. An exceedingly hard, tough, wear resisting metal. The rings show from 38 to 46 on the Rockwell scale *C*, while the valve stems are held between 31 and 32. Metal for the rings and valve stems is melted in four electric furnaces, two of 1000 pounds capacity, one of 500 pounds and one of 250 pounds. The pourers catch the metal direct from the spout of the furnace in hand ladles holding about 60 pounds. The furnaces are located close to the conveyor units so that the metal may be poured immediately after it leaves the furnace.

Equipment

American Bridge Co., Pencoyd, Pa.
American Foundry Equipment Co., Mishawaka, Ind.
Beardsley & Piper Co., Chicago.
Demmler Bros., Kewanee, Ill.
Detroit Sheet Metal Co., Detroit.
Electric Furnace Co., Salem, O.
Holcroft & Co., Detroit.
International Molding Machine Co., Chicago.
Jeffrey Mfg. Co., Columbus, O.
National Engineering Co., Chicago.
Osborn Mfg. Co., Cleveland.
Pangborn Corp., Hagerstown, Md.
Pittsburgh Electric Furnace Co., Pittsburgh.
Robbins Conveying Belt Co., Chicago.
Surface Combustion Corp., Toledo.
Swindell Furnace Co., Pittsburgh.
Whitehead & Kales, Detroit.
Young Bros. Co., Detroit.

Cleveland Firm Buys Vibrator Business

Federal Foundry Supply Co., 4600 East Seventy-first street, Cleveland, has purchased the foundry riddle business of the Lowe Mfg. Co., Detroit, including patents and equipment. Equipment will be moved to the Cleveland plant where all models will be produced. Repair parts for Lowe machines now in use also may be secured from the Federal Foundry Supply Co.

To Meet in Cleveland

The 1936 National Metal congress and exhibition, held under the auspices of the American Society for Metals, will be staged in the Cleveland Public Auditorium, Oct. 19-23.

Analysis of Various Alloy Iron Castings

	Carbon	Silicon	Sulphur	Phosphorus	Manganese	Copper	Chromium	Nickel	Tungsten
Crankshafts	3.30-3.65	0.45-0.55	0.08 max.	0.05 max.	0.15-0.35	2.50-3.00	.....	.....	.....
Cylinders	3.15-3.35	1.80-2.10	0.10 max.	0.25-0.32	0.60-0.80	0.75	.....	.....	.....
Insert rings	1.20-1.40	0.30	0.05 max.	0.05 max.	0.25	1.50-2.00	2.50-3.50	.....	14.00
Valves	0.95-1.20	2.00-3.50	0.05 max.	0.05 max.	.....	.....	14.00-16.00	13.00-15.00	.....

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Write for our interesting booklet 15G "High Speed Abrasive Wheels".

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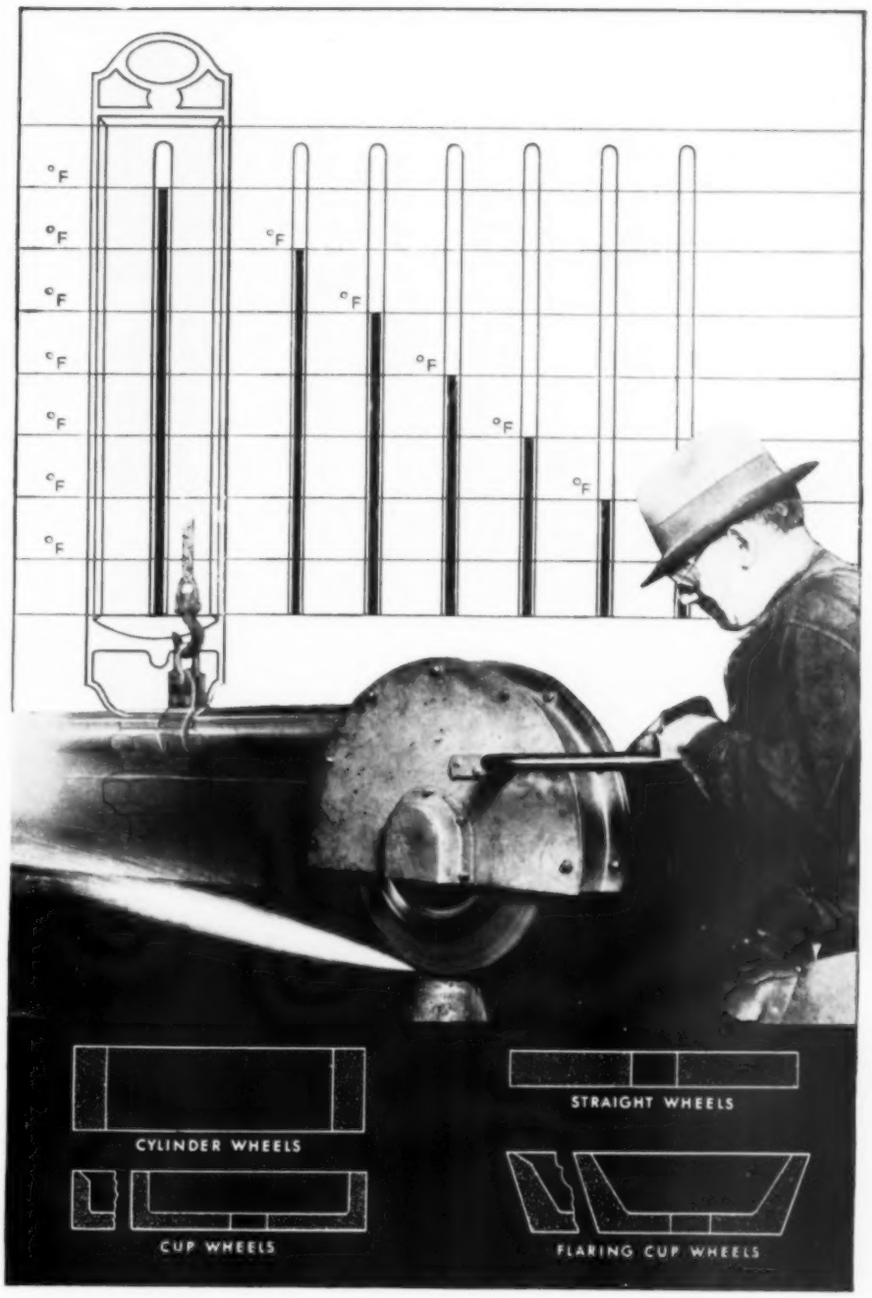

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BONDED WHEELS

FOR ECONOMICAL HIGH SPEED GRINDING

Bonds Steel Molds with Cement

(*Continued from page* 30)

large riser in the center built up to the required height and the metal is poured into the mold as in routine practice. An impeller mold ready for the metal is shown in Fig. 5.

In some instances existing type patterns may be employed in the new process, or readily may be adapted to the process by mounting them on boards with a frame around the edges to convert the assemblage into a corebox. In other instances, and probably these constitute the majority, substantial reduction in patternmaking cost may be achieved by redesigning the pattern equipment to facilitate production by the new method. This is particularly true with large castings where a sectional corebox may be utilized for the production of as many cores as may be required to form the whole or a considerable part of the mold. Where the corebox is made accurately, the resulting cores or blocks of sand may be depended upon to conform to size and shape. They do not swell, sag, shrink or become distorted in any manner and therefore require no rubbing, filing or other extra manipulation to fit them in place in the assembly.

No Fins on Castings

Close fit between the cores eliminates large and unsightly fins and the consequent chipping expense, considered a necessary safety factor on practically all large castings made in dry sand molds in the usual manner. This feature is illustrated strikingly in Fig. 8, a cast steel rack, 24 feet 11 inches in length, 5 feet 6 inches wide, 18 inches high, weight 18,000 pounds. The casting appears as it was stripped from the sand and showing no joint marks between the cores or at the ends or sides. Practically the only chipping or cutting required is that involved in the removal of the feeding heads. Metal entered this mold through single sprue, runner and double gate at the bottom, shown at the extreme left end in the illustration.

This casting also illustrates another advantage claimed for the Randupson process as compared with the method usually employed in the production of large steel castings in flasks. Even where the greatest care is exercised, a large mold is exposed to distortion when it is lifted from the floor in a green state and loaded on a car for drying in an oven. If the oven track is not perfectly parallel, or if the flask is not supported properly on the car, further distortion takes place. Finally in replacing the dried mold on the floor a possibility exists that it may be thrown out of line. The usual equipment in a foundry does not include precision instruments for verifying or correcting errors of this kind.

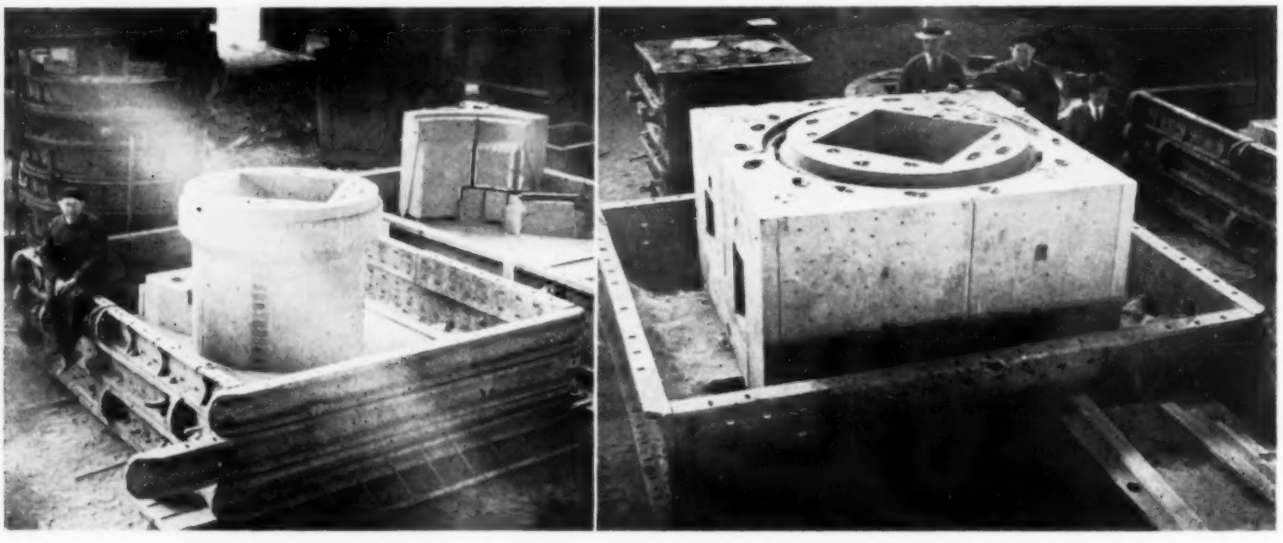
This potential hazard is eliminated in the method shown in Fig. 9 and in other illustrations. The flask is leveled firmly on the floor before the actual work of preparing the mold is commenced. The mold then is built up level and true and is not disturbed again until after it has been filled with metal. Thus in forming the mold shown in Fig. 9 a number of transverse straightedges were erected on a bed of rubble in the drag. Prepared sand was rammed to the top of the straightedges and struck off to form a level bed. A templet was laid on this bed and additional sand was rammed around it. A short strike with a projecting lower edge and with the shoulders resting on the templet was employed to scrape a seat for the rack teeth cores. The templet then was removed and the resulting shallow print served as a guide for setting the outside cores of the mold. Instead of a large bulky pattern, a single corebox served to make the required number of right and left cores for the long T member of the mold. Other cores for the remainder of the assembly were made in a few additional coreboxes. With all the cores in place the remaining space in the flask was filled with rubble and sand and the mold made ready for pouring as previously described.

Brackets May Be Omitted

The mold shown in Fig. 9 illustrates another feature peculiar to the Randupson process, a feature rather foreign to the experience of a steel foundryman accustomed to seeing fins or brackets cut in the corners or where adjoining members of a casting meet at an angle. Occasionally a few brackets may be required in molds made by the process, but in the majority of instances and in positions considered necessary in the usual type of sand mold, they may be omitted entirely. Small chills bedded in the corners of the cores provide the necessary safety feature in these sections of the casting. Nails, wires or prongs cast on the chills, anchor them firmly in the sand.

Another example of the same general technique employed in the construction of a large mold is shown in Figs. 11 and 12. A flat bed is prepared in the bottom part of the drag where additional sand rammed around the edges of a templet form the guide for setting the core blocks. Obviously the mold might be built

(*Continued on page* 74)



Figs. 11 and 12—Two stages in the construction of a typical mold made up of cement bonded sand blocks

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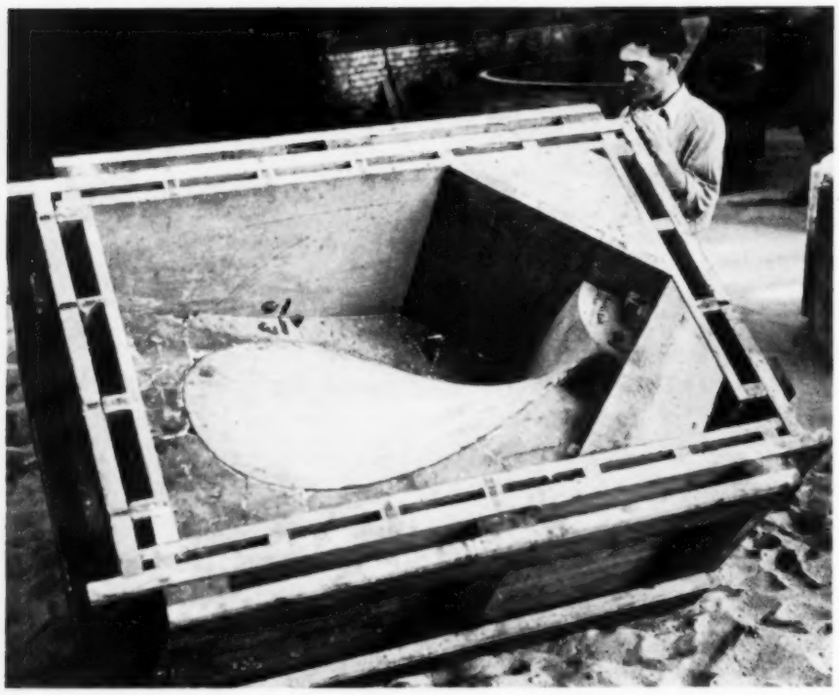

Fig. 13—After the required number of cores have been made for the drag, the corebox is reversed to make the cope cores

(*Continued from page 72*)

up on the floor and bound together later with suitable bands or curbing, but since a large number of flasks in various sizes are available, they are utilized for the purpose. These illustrations also show how accurately the core blocks retain their shape and fit into place in the assembly. Note in particular the absence of practically any clearance between core and print at the bottom of the large circular core in Fig. 11. A miter joint on the corners of the four sections making up this unit provides the necessary strength to resist the pressure of the metal. A miter joint with a step near the outer line insures rigidity in the outside sections. Stud chaplets support the overhanging parts of the outside cores and also are placed at several points near the top edge of the vertical space between the core and the outer part of the mold. This is to prevent any movement of the outer cores when they are braced on the outside from the wall of the flask. Covering the mold with flat cores, setting the runner and risers, packing the space between flask and cores and other details follow routine practice.

Simplified pattern equipment for making a propeller wheel is shown in Fig. 13 while the finished casting is shown in Fig. 14. Construction of the equipment and application of the method may be varied to a considerable extent, depending principally on the size of the casting and the number required. Thus the equipment may be all wood, a combination of wood and plaster, or—a rather remote contingency where a great number of duplicate castings are required—all metal. The equipment shown in Fig. 13 is for a steel wheel 8 feet 8 inches diameter, 21 inches high and weighing 3847 pounds.

Cope and Drag Matchplate

Briefly the method shown in Fig. 13 resolves itself into a cope and drag matchplate surrounded by a frame deep enough to make both parts separately. In one application the frame serves to enclose the required number of drag cores, while in the second application, by reversing the position of the frame, it serves to enclose the required number of cope cores. In the illustration the assembly is in position for forming the drag cores. Exceptions are noted occasionally, but almost invariably the driving face of a propeller is formed in the drag of the mold. By the driving face is meant the face nearest the vessel.

In any application of this method only one blade and a partial hub are required for the pattern. Since in this particular instance the complete wheel is to have four blades, the

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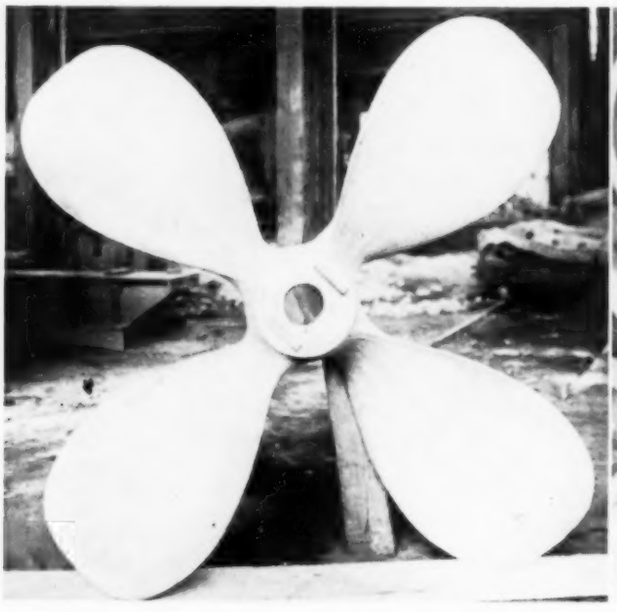

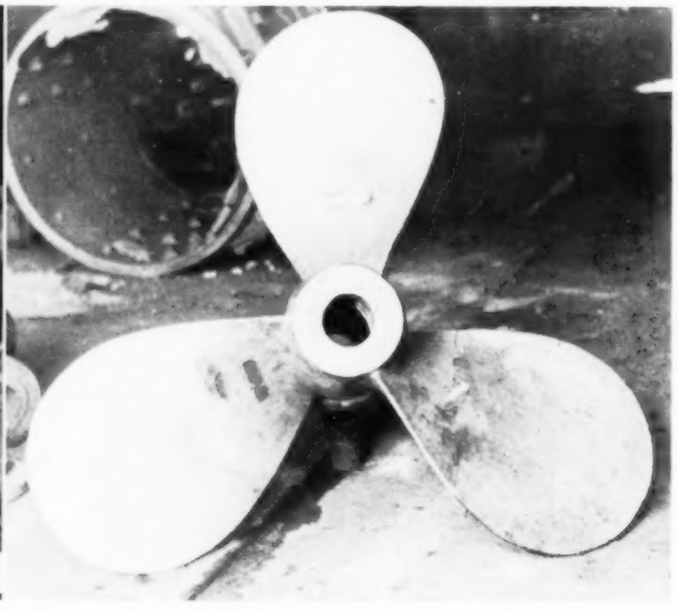

Fig. 14 (Left)—Steel propeller casting made according to the Randupson process. Fig. 15 (Right)—Manganese bronze propeller casting 8 feet diameter made according to the same process

(*Concluded from page 74*)

hub is a quarter section. A suitable cradle atttached to the bottom board supports the pattern with a center line through the hub vertical and a center line through the blade parallel to the bottom board. The outside frame constituting the walls of the corebox is placed on the board. The wood cradle is built up to conform approximately to the anticipated joint line of the mold and then the surface is covered with plaster and slicked off as in making the parting on any mold with an irregular parting line.

The pattern and sides of the corebox are lined with a thickness of cement bonded sand, while the interior is filled with cinders or with reclaimed material from the cleaning room. Two sets of hooks are placed to facilitate lifting the core from either side. The final course of prepared sand is rammed and the surplus sand scraped off flush with the upper edge of the corebox. A flat plate is adjusted in place and the assembly is rolled over. The corebox is removed, inverted and placed back in its original position where the performance is repeated for the three additional cores required.

Only One Matchplate Used

Instead of constructing a second matchplate on which to ram the cope cores, the dried drag cores are pressed into service. The frame of the corebox is removed, inverted and dropped over one of the cores. The pattern for the blade and hub also is removed from its first setting and placed in the impression in the core. The corebox is filled with sand, etc., as in the first instance. A plate is placed on top and the entire assembly is rolled over. The corebox and dried drag core are removed, turned over and reassembled successively for the three remaining cope cores.

In making the mold a level bed is swept in a pit, in a flask or on the floor and a ring marking the outer ends of the cores is scribed on the surface. Four marks equal distances apart are placed on this ring, either with a straightedge and square or with the aid of a pair of long dividers. A corresponding mark in the center of the outer end of each core guides that part of each core accurately into place. The inner ends of the four cores automatically adjust themselves in correct position. In an alternative method a templet conforming to the outer contour of the four cores is placed on the bed and a shallow print is formed. The four cores are lowered into this print with the assurance that they are in proper relative position to each other and that the resulting wheel will be truly circular and accurately balanced.

With the four drag cores in place, the four corresponding cope cores are adjusted in position, after which the runner and riser are made up and the mold is clamped or secured in the usual manner.

In an alternative method only the cope cores are made in the corebox. The drag parts are built directly on the bed. The pattern is mounted in the corebox in the reverse position to that shown in Fig. 13 and the four cope cores are made in the manner already described. A level bed is swept and the pattern is mounted on a spindle. Four equidistant points are marked on a ring as in the first instance, with the exception that in the present instance the ring is of smaller diameter and coincides with a mark on the lower edge of the blade pattern. The pattern is adjusted over the first mark and sand is rammed under and up around the pattern approximately to the parting line. One of the cope cores is lowered into place until it rests accurately on the pattern. Sand around the edge is then tucked up against the projecting edges of the core. Position of the core is marked either by stakes, or by vertical scratches in the face. The core then is removed temporarily. The pattern is lifted and swung around to the second position where the operation is repeated. In the meantime the first core is replaced on the first drag. The remaining three sections of the mold are made in a similar manner.

Organize Section On Safety and Hygiene

With a view to making more effective the work the American Foundrymen's association has carried on for a number of years on plant safety, good housekeeping, and protection of foundry workers, a Safety and Hygiene section has been organized to accomplish the following purposes:

To determine further the extent of hazards to safety and health in the foundry industry; to study causes of hazards and methods of prevention, and to provide further protection to workers against exposure.

Co-operation with other centralized agencies of industry confronted by similar problems, in assembling and making available information on this subject.

Co-operation with public health agencies, insurance carriers, and the medical profession in forwarding health measures.

Assisting in standardization of dust elimination equipment and improvement of shop operating conditions in the foundry industry through active educational work.

Promoting standards for dust elimination and control equipment, in co-operation with agencies of the manufacturers of such equipment.

Giving encouragement by active means where enactment of equitable and fair compensation laws is sought in industrial states.

E. O. Jones, for many years associated with Belle City Malleable Iron and Racine Steel Casting Companies, Racine, Wis., and for the past 3 years consultant of industrial relations bureau of the National Founders association, has been made director of the Safety and Hygiene section, and will have his office at the headquarters of the American Foundrymen's Association, 222 West Adams street, Chicago.

A plan has been arranged with the Saranac Laboratory of the Edward L. Trudeau Foundation for research and consulting service. Under this arrangement the services of D. E. Cummings, Field Director of the Saranac Laboratory, can be secured by individual foundries or groups of foundries, through the Safety and Hygiene section of A. F. A., for consultation or discussion of general policies dealing with medical and engineering control procedure designed to protect the health of foundry workers.

Outlines Practice In Training Supervisors

A report of a survey, entitled "Training Supervisors and Key-Men" which presents an outline of the practice of 85 companies, has been published by the Policyholders' Service bureau of the Metropolitan Life Insurance Co., 1 Madison avenue, New York.

The publication points out a clearly defined purpose is essential to the success of training programs. Analysis of the training methods of 85 companies shows that there are three predominating objectives: (1) providing foremen with an opportunity to acquire information, (2) helping them to think clearly about their jobs, and (3) developing ability in doing what is required of them. Methods of training discussed in the report vary from the studied formality of conference method to schedules of lectures on such subjects as economics, psychology, time study and cost accounting, also on company organization and history, products, markets, plant policies and practices. The report, referring to discussions used in connection with training lectures, states that it has been found that information acquired through such methods is better understood and more readily accepted.

Essentials for success in such a program include active interest from the management, a competent leader, a carefully selected group and practical subjects for discussion. The report may be obtained from the Metropolitan Life Insurance Co.

Progress Charts Reduce Costs

(*Concluded from page* 31)

ly by having each category of workers do its own respective work, and sometimes by a new layout of equipment in the shop. The process in certain instances has to be revised and an entirely new one substituted.

In a certain steel foundry the scrap was broken to charging box size under a drop ball of the old tripod type with a trip hook on the hoist.

Foundry scrap was collected on the cleaning room floor by the traveling overhead crane and two chainmen. After a carload was collected it was loaded on the car by the crane. The loaded car was coupled to a switch engine and taken to the yard where a locomotive crane unloaded the scrap near the ball breaker. The broken castings, gates, etc., were thrown onto a heap from which the locomotive crane would load a car of supposedly chargeable size pieces. The loaded car was taken by the switch engine to the melting department where it was unloaded by a magnet on an overhead traveling crane.

Scrap Proved Too Large

The pieces of supposed chargeable sizes often were too large to go through the charging doors of the furnace. This meant that the journey must be repeated for the unchargeable pieces. Amount of these pieces varied from 10 to 20 per cent of all the scrap prepared. Approximately 5 carloads of scrap were broken each week in normal times. An extra carload was then necessary for the unsatisfactory pieces.

The foregoing procedure laid out on a process chart is shown in Table I.

Analysis of this chart shows that to prepare 35 to 40 tons of chargeable foundry scrap requires 8.3 hours of skilled labor as crane operators and engine drivers, and 39.4 hours of unskilled help. The process on the whole was very laborious, entailed excessive handling of material and was out of date.

Following an analysis of the chart it was decided to cut the scrap with a torch into chargeable size pieces on the location where it was accumulated. A good burner was able to cut into chargeable sizes a carload of scrap in approximately 6 hours. Cost of fuel, a mixture of oxygen and city gas, amounted to almost 8 times the power consumed by the ball breaker motor. On the chart the cost of the cutting gas mixture is transferred to electrical units for ease of comparison.

A process chart of the new method was then made as shown in Table II and used as an instruction sheet by the foreman of the department which was charged with responsibility for the work.

Results of the new method show an increase of less than 2 hours in skilled help and a decrease of 37 hours in unskilled help per carload lot. Using arbitrary base rates for the men employed and the cost of electric service at 2 cents per kilowatt the resultant savings are shown in Table III.

Savings effected by the new method are self-evident. When figured in man hours the yearly amount is worthy of consideration even though the present rate of production is somewhat decreased.

Many similar instances can be found. Where the procedure is analyzed and studied by the help of process or flow charts, substantial savings will be realized. Many foundry executives will be surprised to see their method of handling incoming orders, both in the clerical end and in the shop on a process chart where the entire picture can be seen at a glance.

Shipping and billing systems have been process charted in different shops with favorable results. A flow chart of crane service in a New England shop showed that a total weight of 285,000 pounds was hoisted to complete a 5,000 pound casting from start to finish! The red ink will begin to disappear when foundry management analyzes and studies methods of doing work to eliminate useless steps and motions that increase the cost of producing castings. Seemingly simple operations placed on paper by sequence of motions will present a different appearance. It will be found that many steps can be eliminated entirely.

Table III

Comparison of Costs Illustrating Savings

Per Carload Lot

Old Method				New Method			
Unskilled help	39.4 hours at	$0.50 =	$19.70	2.4 hours at	$0.50 =	$ 1.20
Skilled help	8.3 hours at	.80 =	6.64	10.15 hours at	.80 =	8.12
Power	65 kilowatt at	.02 =	1.30	520 kilowatt at	.02 =	10.40
Total			$27.64	Total			$19.72

Table II

Process Chart on Handling Scrap

Improved Method

Element No.	Description	Men — Skilled	Men — Unskilled	Time in Hours — Skilled	Time in Hours — Unskilled
1	Assemble and collect all the foundry scrap on floor	1	2	1.0	2.0
2	Burner cuts up scrap into chargeable pieces	1	0	6.0	0
3	Car of scrap loaded by crane equipped with magnet	1	0	1.75	0
4	Car is coupled to yard switch engine	1	1	0.1	0.1
5	Loaded car taken to melting dept. by switch engine	1	1	0.2	0.2
6	Car uncoupled from switch engine	1	1	0.1	0.1
7	Car unloaded by melting dept. crane with magnet	1	0	1.0	0.0
	Total			10.15 hrs.	2.4 hrs.
	Power consumption (Fuel for gas torch equivalent)			520 Kilowatts	

California Founders Hear Talk on Pig Iron

G. L. Von Plouck, chief metallurgist, Columbia Steel Co., Pittsburgh, Calif., gave a talk before the Northern California Chapter of the American Foundrymen's association on Jan. 10.

C. M. Henderson, H. C. McCauley Foundry Co., and chairman of the chapter, presided at this meeting, which was held at the Whitcomb Hotel, San Francisco. Mr. Von Plouck's talk, which was heard by some forty foundrymen, was an interesting review of processing methods of pig iron from the blast furnace to the finished casting. The speaker prefaced his remarks with an outline of the history of iron production in the West, which has now centered in Provo, Utah, where there is a larger modern plant in operation.

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Three factors in better, faster, cheaper cleaning — Proper abrasive, proper nozzle, efficient application

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The best abrasive and top-notch equipment will still not show maximum operating economy unless equipment is properly applied to the cleaning process. Great Lakes Engineers will, upon request, check your cleaning room equipment, recommend changes in application to effect economy of abrasive, of labor, of time, of power. Their recommendations have saved thousands of dollars for our customers. Write us today about this service.

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In competitive tests they consistently show less wear and therefore make a definite saving on one of the most important items of cleaning cost—AIR.

Also hard alloy iron sand blast nozzles, all sizes. Write for prices.

Pittsburgh Group Holds January Meeting

Owing to subzero temperatures, attendance at the January meeting and dinner of the Pittsburgh Foundrymen's association held at Pittsburgh, Monday, Jan. 20, was unavoidably restricted. Approximately 60 members and guests, however, attended the meeting, the highlight of which was a talk by F. C. T. Daniels, research engineer, Mackintosh-Hemphill Co., Pittsburgh, on "Some of My Experiences While Abroad."

Mr. Daniels, who is a member of the executive committee of the Pittsburgh Foundrymen's association, recently returned from a visit to Germany and Scotland that lasted several months. He had a number of interesting experiences to relay to members of the association.

The second speaker of the evening was H. B. Mellor, managing director of the National Air Hygiene Foundation and chief of the bureau of smoke regulation for the City of Pittsburgh. His address was on the subject of "Pneumoconiosis."

Tentative date for the February meeting of the Pittsburgh Foundrymen's association is Feb. 17.

New Jersey Group Features Gray Cast Iron

W. G. Reichert, metallurgist, Singer Mfg. Co., Elizabeth, N. J., spoke on "The Manufacture of Gray Iron Castings" at the January meeting of the New Jersey Foundrymen's association held Jan. 29 in the Downtown club, Newark, N. J. Mr. Reichert pointed to the importance of certain principles of design; explained the metallurgical theory of machinability, resistance to wear, corrosion, heat, etc., and described various methods of attaining these qualities by the use of alloys. He emphasized the necessity of providing a base composition which is right before using alloy addition. He also discussed the control of weight of air entering the cupola, the hot blast cupola, the use of purite in the forehearth, and the use of larger percentages of scrap. His talk was illustrated with lantern slides.

W. H. Cole, Moore Bros. Co., Elizabeth, N. J. and president of the association, presided. H. L. Edinger, Barnett Foundry & Machine Co., Irvington, N. J., and chairman of the apprenticeship committee, reported that the apprentice training program of the association, initiated in December, was making progress. He stated that many foundries had agreed to put on additional apprentices and that the association intended to follow the program until every local foundry was training a fair quota of apprentices. Several other members discussed that question, stressing the urgent importance of training an adequate supply of skilled men.

A.F.A. Publishes Papers on Health Hazards

Four papers presented at two important sessions relating to dust control, health hazards and employer responsibility, held at the recent Toronto convention of the American Foundrymen's association, have been issued in reprint form by the association.

"Industrial Health Hazards and Employer Responsibility" is the subject discussed from the medical and administrative standpoint by Dr. W. J. McConnell, director, Industrial Health section, Metropolitan Life Insurance Co., and Donald E. Cummings, field director, Saranac Laboratory, Saranac Lake, N. Y.

A paper by S. D. Moxley, chief engineer, American Cast Iron Pipe Co., Birmingham, Ala., reviews the mechanical aspects of dust collection in foundries and presents data on various types of collectors.

The fourth paper, by J. D. Leitch, Ontario department of health, discusses dust as a health hazard, and equipment for removing dust.

The pamphlet also contains a report of the discussions developed at the two meetings. Copies may be obtained through the association at 222 West Adams street, Chicago.

Chicago Chapter Studies Iron and Scrap

Pig iron and scrap were topics for discussion at the monthly meeting of the Chicago chapter, American Foundrymen's association, Jan. 20. Attendance was about 90. Talks dealt principally with the classifications and specifications of pig iron and ferrous and nonferrous scrap.

C. O. Thieme, H. Kramer & Co., presented the classifications for the important grades of nonferrous material. He indicated that much constructive work had been done in providing uniform specifications for such scrap, but that the wide variety of grades and chemical compositions make it advisable for the buyer to use care in his selections.

E. G. Howell, Erman-Howell & Co., described iron and steel scrap specifications and problems of ferrous scrap use. Lack of uniform specifications for foundry grades of old material was deplored.

George Long, Pickands, Mather & Co., discussed the various analyses of pig iron and their applications, as well as the effect of chemical composition on physical characteristics.

Birmingham Groups Plan Sectional Meeting

The fourth annual foundry practice meeting, sponsored jointly by the Birmingham section of the American Society of Mechanical Engineers and the American Foundrymen's association, is scheduled to be held at the Hotel Tutwiler, Birmingham, Feb. 27 and 28.

Extensive plans for an interesting conference and plant visitation program are being made by a local committee under the chairmanship of T. J. Carpenter, Republic Steel Corp., representing the A.S.M.E., and R. R. Deas, American Cast Iron Pipe Co., representing the A.F.A.

The tentative program of the meeting is as follows:

Thursday, Feb. 27

9:00 a.m. Registration.

10:30 a.m. TECHNICAL SESSION — T. Johnson and H. J. Noble, Presiding.

"Problems in the Manufacture of Foundry Coke," by G. R. Ozley, plant engineer, Alabama By-Products Corp.

"Grinding in the Foundry," by B. N. Hodges, Engineer, Carborundum Co.

12:30 p.m. LUNCHEON — Tutwiler hotel—R. A. Polglaze, Presiding.

2:30 p.m. TECHNICAL SESSION—G. S. Evans, Presiding.

"The Place of Alloys in Cast Iron," by V. A. Crosby, Metallurgist, Climax Molybdenum Co.

"The Practical Operation of a Stove Foundry Equipped with a Continuous Pouring System," by G. O. Stanley, General Superintendent, Dortch Stove Works.

5:00 p.m. OPEN HOUSE—Pine Room, Tutwiler hotel.

T. H. Benners, Jr. and J. Hayes, in charge.

Friday, Feb. 28

9:30 a.m. TECHNICAL SESSION — Walker Reynolds, Presiding.

"Practical Foundry Sand Control," by Harry W. Dietert, Chief Engineer, U. S. Radiator Co.

10:30 a.m. ORGANIZATION MEETING of Birmingham District Chapter of American Foundrymen's Association.

12:30 p.m. LUNCHEON—Republic Steel Corp., Host.

2:30 p.m. TECHNICAL SESSION—R. E. Kennedy, Presiding.

Discussion of A.F.A. "Cast Metals Handbook," with Dr. J. T. MacKenzie, Metallurgist, American Cast Iron Pipe Co., as discussion leader.

6:30 p.m. ANNUAL BANQUET — Jos. W. Eshelman, Presiding.

Toastmaster—W. Carson Adams.

Guest Speaker—W. L. Batt, President of S. K. F. Industries, Inc. and National President of A. S. M. E.

ADVERTISING PAGES REMOVED

Castings A Feature At Road Show

VISITORS at the 1936 Road Show, held recently in Cleveland, were impressed with the large tonnage of castings employed in the manufacture of road making and maintenance equipment. From the enormous road leveling equipment and the immense excavators to the small markers placed in the pavement to assist in directing traffic, castings played a prominent part.

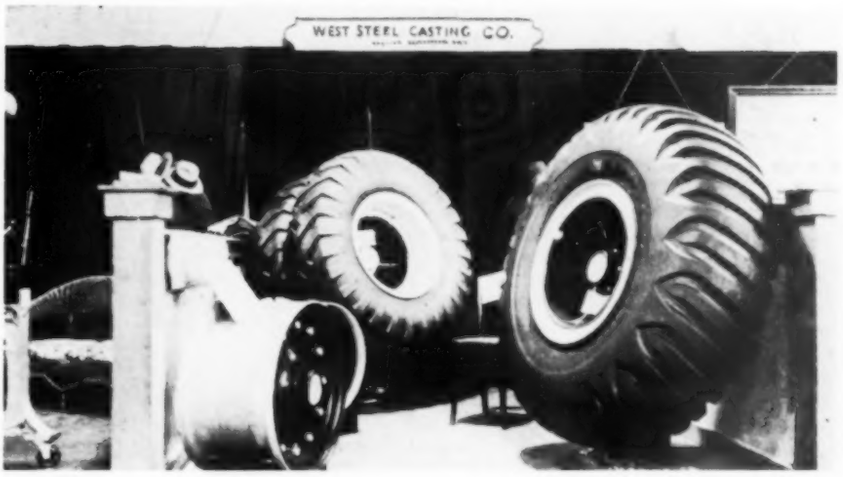
Several foundries were represented with displays of castings, including the American Casting Co., Birmingham, Ala.; the American Manganese Steel Co., Chicago; American Brake Shoe & Foundry Co., New York; Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; and the West Steel Casting Co., Cleveland. Other foundries, such as the Continental Roll & Steel Foundry Co., East Chicago, Ind., showed castings used in units such as bulldozers, trail-builders, scrapers, rippers, etc. A study of the exhibitors showed that a surprisingly large number operate foundries.

One of the most interesting exhibits was that maintained by the Interlake Iron Corp., Chicago, showing cast iron blocks for paving roads. The Interlake company is installing a permanent mold foundry at its Toledo blast furnace, where metal from the furnace will be refined in the air furnace and then poured in the molds.

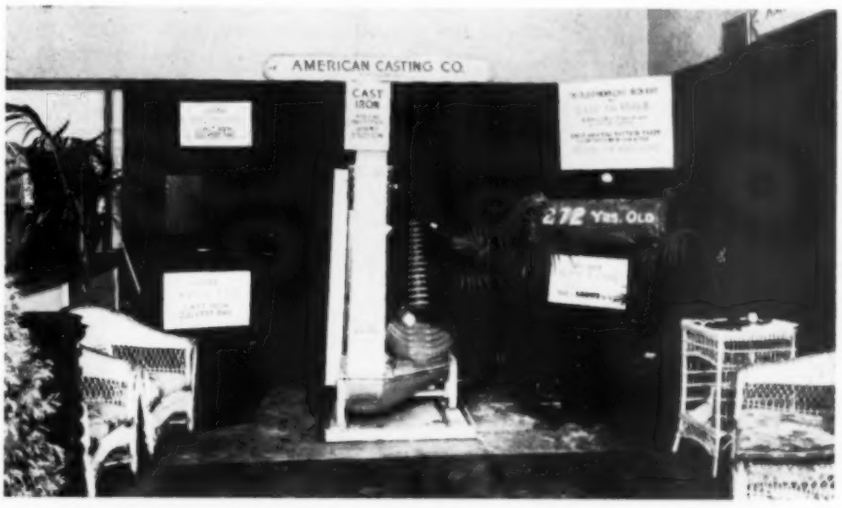
A number of foundrymen from quite a widespread territory attended the show.

Publishes Report On Shop Maintenance

Policyholders' Service bureau, Metropolitan Life Insurance Co., 1 Madison avenue, New York, recently has issued a report, "The Maintenance Department." Executives quoted in the report believe that the cost of lost production time due to a breakdown and its repair should be added to the cost of the repair and the entire amount charged to the maintenance department. Other equally interesting comments, particularly concerning practices and procedures, are presented in the report which is the result of a survey of the practices of several representative companies. Organization, operation and control methods are discussed in detail.



Wheels and tire mountings exhibited by the West Steel Casting Co., Cleveland. The large front wheel is 18 x 24 inches with tire



Corrugated cast iron culverts of the American Casting Co., Birmingham, Ala.

Cast iron paving blocks shown by Interlake Iron Corp., Chicago, with plant in Toledo. The blocks are of three point suspension type

Constructs Small Size Cupola

(*Concluded from page 34*)

inches are cast iron lined with fire brick. The four tuyeres are cast iron 1 x 2 inches at the shell and flared to 8 inches inside the lining. This gives a total tuyere to cupola area ratio of 1 to 22. The bottom of the tuyeres is 2 inches above the sand bottom. The blower has a capacity of approximately 250 cubic feet of air per minute to correspond with the melting capacity of the cupola, approximately 1000 pounds per hour. To meet varying conditions the blast volume may be regulated by a gate in the blast pipe. Assuming that coke occupies half the space, the well of the cupola will hold about 50 pounds of iron before each tap.

From 40 to 45 pounds of coke on the bed will extend about 12 inches above the tuyeres. The coke is broken into small pieces. Subsequent coke charges weigh about 15 pounds and iron charges, also broken into small pieces, about 90 pounds.

Mixtures containing nickel and chromium, noncorrosive metals, iron copper mixtures, and iron steel mixtures are melted without trouble. The cupola also is adapted to melting phosphor bronze, aluminum bronze, high pressure metals, metals that have to withstand high tensile and compressive stresses, experimental mixtures by metallurgists in their observations and metallurgical research. Charcoal as fuel is preferable to coke. It is more expensive, but under certain conditions, for example in the production of a special metal, it is more economical.

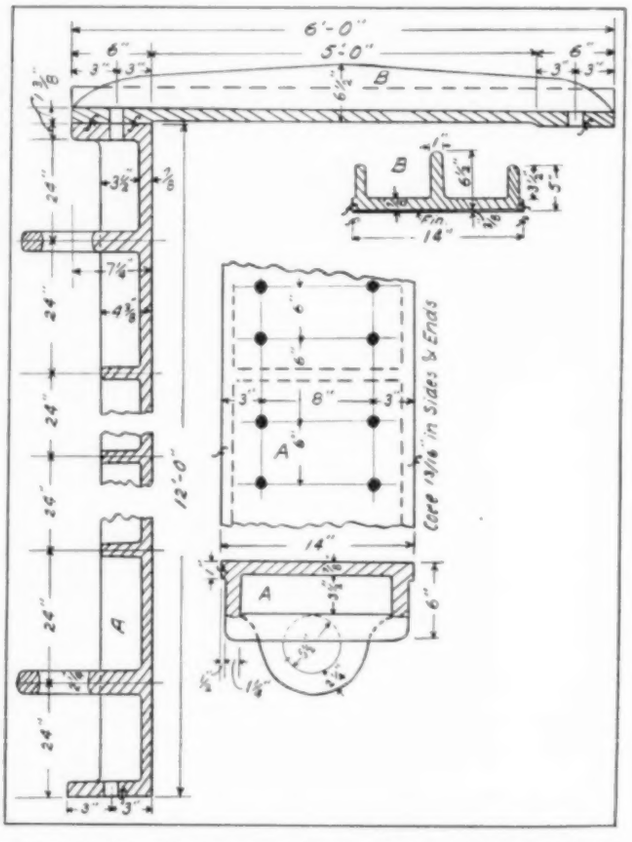
Where copper is melted in the cupola for a bronze mixture, the tin and zinc are added in the ladle, either before or after the copper is tapped into it. Where coke is used for fuel, the sulphur content should be low. Where the metal is melted in a crucible, it is optional whether or not the entire stack is employed. Use of the stack is preferable since it carries away gas and fumes. The lower half of the crucible is moved from under the stacks before the pot is lifted with a tongs in the usual manner. The upper part of the stack is suspended from the roof beams, or a wall bracket in any convenient manner. This feature will depend on local conditions, including the position occupied by the cupola in relation to the end or side wall of the building.

Assemble Flask Sections in Combination

By R. M. Cheney
Cleveland

ONE of the greatest problems confronting the foundryman engaged in the production of machine tools and other miscellaneous heavy castings, is the almost constant changes of design. This in turn involves many changes in the length, width, depth and bar arrangement in the flasks. The logical solution of the problem is to adopt a definite standard of sizes for flask sections. These sections then may be assembled in any desired combination. A raised strip 1-inch wide and ½-inch high on the ends and sides of each section is machined thus assuring a tight and accurate joint when one section is bolted to another. The side and end sections may be made in 2, 4, 5, 6, 7 and 12-foot lengths, and either 12 or 16 inches deep.

Short filler sections may be inserted or removed at any time to increase or decrease the length or width. Bars, either straight, or conforming to the shape of a pattern molded partly in the cope, are cast in open sand molds. The flask sections also are cast in open sand molds. A two part dry sand core forms the handle by which the crane chain hook is attached. Detail of the side and end sections for a flask 5 x 12-feet inside are shown in the accompanying illustration. Bolt holes are cored in the sides and ends of all sections for the attachment of bars in the cope, stiffener bars in the drag, or chuck bars in a cheek. With a supply of these parts on hand, changes can be made quickly and at little expense. In fact the only expense is the time involved in making the change, and a few new bolts occasionally.



Detail of side and end parts for a flask 5 x 12 feet inside, 14 inches deep. The end weighs 600 and the side 1185 pounds

Book Review

Handbook of Chemistry and Physics, 20th edition, fabricoid, 1951 pages, published by the Chemical Rubber Co., Cleveland, and supplied by THE FOUNDRY, Cleveland, for $6.00 plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., London.

The aim of the editors and publishers of this handbook throughout its various editions has been to present in condensed form as large an amount of accurate, reliable up-to-date information in the fields of chemistry and physics as is consistent with convenience of form and the possibility of wide utility and distribution. This aim has been continued in the present edition.

New and revised material includes a table of physical constants of organic compounds. The most important feature of that table is the nomenclature worked out by Dr. Austin M. Patterson, vice president and professor of chemistry at Antioch college. Insofar as possible, every organic compound appearing in that table has been named in accordance with the rules laid down by the International unions.

To further improve the organic table and increase its usefulness, it has been changed from the tabular form to the paragraph or dictionary style.

A formula index of organic compounds, a table comprising about 30 pages, has been added. General rules of pronunciations of chemical names and a list of names with recommended pronunciations has been included.

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MOLDING MACHINES

WITH AUTOMATIC DRAW AND ROLL-OFF

After the mold is jolted and squeezed, following the exhausting of the air and on the down stroke of the piston and after the pattern is partially drawn and with the piston and pattern continuing on the down stroke, the mold then on the rolloff attachment is raised to clear the flask pins. This is automatically done and is performed smoothly by gravity and, without any additional valves, cylinders or power, the mold is then rolled out of the back of the machine on to a mold conveyor or temporary storage conveyor.

These improvements are protected by U. S. Patents Nos. 1,277,745; 1,472,807; 1,545,817 and 1,656,951. Other patents pending. Patented in foreign countries.

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Gray Cast Iron (*Chapter VI Continued*)

(*Continued from page 35*)

40.07; melting point, 1490 degrees Fahr.; density, 1.54; and crystal lattice, hexagonal close packed.

Calcium in solution in cupola melted iron is most unlikely, although calcium as a silicate is a common constituent of entrained slag. Little is known about the effects of metallic calcium on cast iron. It apparently raises the combined carbon somewhat, resulting in some slight strength increase. In the experiments of Mantell and Hardy 0.5 per cent calcium added resulted in 0.2 per cent retained.

Use of calcium silicide as a deoxidizer is common practice in many steel foundries. Its use in cast iron has been patented. This material has been used as a graphitizing and deoxidizing agent by the manufacturers of Meehanite cast iron. According to the patent iron is melted with relatively low silicon and siliconized with calcium silicide. This method of adding silicon, i.e. as calcium silicide, is said to be more effective than that of adding ferrosilicon and pure silicon. It also is said that the deoxidizing effects of small percentages of calcium silicide added to molten gray irons are markedly advantageous. By suitable adjustment and manipulation metal of excellent strength and toughness can be obtained from suitable base irons. Apparently little calcium remains in the iron.

References—Calcium

1—Smalley—*Engineering*, vol. 114, page 277, 1922.
2—Mantell and Hardy—*Metal Progress*, April, 1932.

Effect of Cerium

CERIUM has the following properties: Atomic weight, 140.25; melting point, 1184 degrees Fahr.; density, 6.79; and crystal lattice—hexagonal.

Appreciable percentages of cerium are not found in cast iron melting stock. The literature on the effects of cerium on cast irons is rather conflicting.

Moldenke and Spring both claim that small additions of cerium are beneficial to the mechanical properties. They attribute these effects to deoxidizing and Spring, to the desulphurizing action. Schwartz and Guiler state that cerium and related rare earth metals interfere with graphitization of white iron.

On the other hand, Smalley and Piwowarsky state that cerium is without appreciable influence on the properties of cast iron.

Cerium has been tried out only in small percentages and its influence without doubt depends upon the character of the base irons to which it may be added. W. F. Chubb, *Metallurgie*, December 1933—states that 0.15 per cent cerium causes an 18 per cent increase in transverse strength and better deflection. Cerium makes the melt more fluid but it has little or no effect as a cleaner.

References—Cerium

1—Moldenke — *Transactions*, American Foundrymen's Association, vol. 27, page 368, 1919.
2—Smalley—*Engineering*, vol. 114, pages 277-278, 1922.
3—Spring—*Transactions*, American Foundrymen's Association, vol. 30, pages 629-630, 1922.

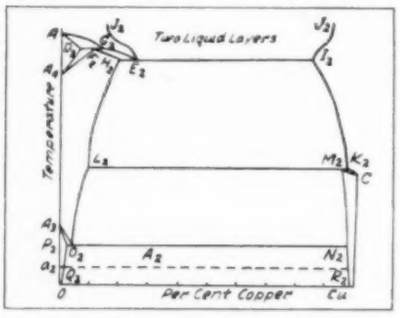

Fig. 91—Binary iron-copper system according to Ruer and Goerens

4—Schwartz and Guiler—*Transactions*, American Foundrymen's Association, vol. 33, pages 639-645, 1925.
5—Piwowarsky - Hochwertiger Grauguss, page 268, 1929.
6—Chubb—*Metallurgia*—December, 1933.

Effect of Cobalt

COBALT has the following properties: Atomic weight, 58.97; melting point, 2696 degrees Fahr.; density, 8.71; and crystal lattice of α—cobalt is face centered cubic.

According to Piwowarsky and Bauer addition of 1 per cent cobalt to an iron 3.90 total carbon, 0.69 combined carbon, did not change combined carbon or brinell hardness appreciably, but reduced the transverse strength about 45 per cent and the tensile about 10 per cent. Addition of 1.90 per cent cobalt increased the combined carbon from 1.01 per cent in the base iron to 1.29 per cent in the alloyed iron, but brinell hardness was raised but slightly. Transverse strength was reduced over 50 per cent and tensile reduced about 7 per cent.

Reed states that cobalt graphitizes medium and high carbon steels. In an 0.53 per cent carbon steel, 8.55 per cent cobalt produced 0.09 per cent graphite and in a 1.13 per cent carbon steel similar results were produced by 9.06 per cent cobalt. Smaller amounts produced no graphitization and further cobalt additions increased it but slightly.

Cobalt displaces the eutectoid to the right—with 3 per cent cobalt eutectoid is at 1.24 per cent carbon. The critical range is raised, and cobalt apparently dissolves in the ferrite.

References—Cobalt

1—Piwowarsky and Bauer—*Stahl und Eisen*, vol. 40, page 1300, 1920.
2—Reed—*Transactions*, American Society for Steel Treating—vol. 20, No. 2, pages 156-158, 1932.

Effect of Copper

COPPER is found in small quantities in some pig irons, especially if sponge iron from leached residues from copper refineries is used in their production, and in some types of low carbon corrosion resisting steels. It also may be found occasionally in scrap. Copper content is not materially reduced in cupola melting of cast iron.

Copper is a red metal with the following characteristics: Atomic weight 63.57; melting point 1981 degrees Fahr.; density 8.93; and crystal lattice face centered cubic.

According to the iron-copper binary diagram of Ruer and Goerens, Fig. 91, iron is capable of holding less than 1 per cent of copper in solid solution. At higher percentages an iron copper eutectoid is found.

In the ternary alloys of iron, copper and carbon specimens containing 4.37 per cent carbon (about the same percentage of carbon found in the eutectic of the iron carbon series) and 3.0 per cent copper closely approach an eutectic structure. With 3.5 per cent copper small globules of free copper are found (Ishiwara). That is from zero to about 3 per cent copper the carbon concentration of the iron carbon eutectic is not altered. The ternary eutectic (4.3 per cent carbon, 3.0 per cent copper, 93.7 per cent iron) solidification temperature is about 77 degrees Fahr. lower than that of the iron carbon eutectic.

A ternary eutectoid occurs at 0.9 per cent carbon and 1.75 per cent copper, forming at 1303 degrees Fahr. (Ishiwara). Reed found a eutectoid structure in 1.13 per cent carbon steel at 8.72 per cent copper, formed at 1196 degrees Fahr. Evidently sufficient copper addition increases the carbon content of the eutectoid and lowers the transformation temperature.

Copper lowers the eutectoid transformation temperature quite materially. In conjunction with nickel (in the austenitic irons) the cumulative action of these two elements is quite marked, practically fully austenitic matrix structures being obtained with nickel contents much lower than would otherwise be required.

Various investigators indicate that the solubility of copper in cast irons is between 3 and 5 per cent. Its solubility in commercial irons undoubtedly is affected materially by the

(*Continued on page 88*)

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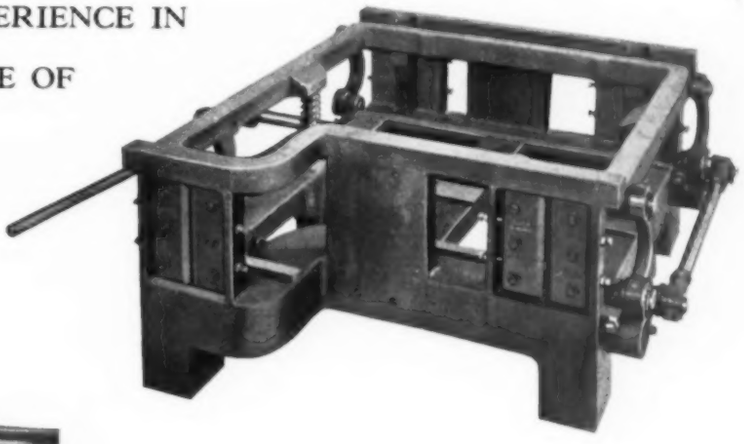

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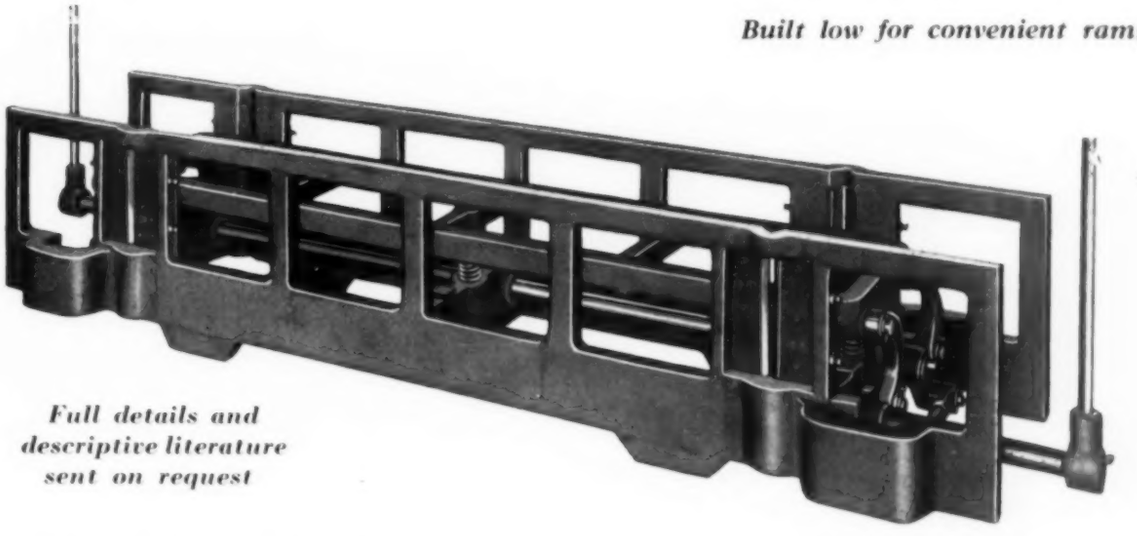

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(*Concluded from page* 86)

presence of other elements, the percentage of total carbon, etc. Manganese, aluminum and nickel evidently increase the solubility. In presence of about 14 per cent nickel about 7 per cent copper practically is dissolved completely, in low carbon cast irons. Some experiments by the author indicate that over 10 per cent copper can be retained in presence of 16 per cent nickel and 16 per cent chromium. With 5 per cent chromium and 10 per cent copper much of the copper separated.

Has Graphitizing Action

Most investigators agree that copper has a mild graphitizing action on cast irons. It apparently is without marked effect on the tensile strength or hardness of gray irons, slight increases usually being noted when copper is added. According to Hurst, copper additions of 0.48 to 1.15 per cent progressively lower the hardness of a 0.60 per cent chrome, 2.05 per cent silicon, 3.25 per cent carbon iron from a brinell of 360 to 268, the combined carbon being reduced from 1.55 to 0.58 per cent, see Fig. 92.

The copper addition apparently lessens corrosion attack by sulphuric acid but is of little benefit in lessening corrosion by ordinary waters. However, Pfannenschmidt claims increased resistance to the action of steam.

Copper forms a phosphide Cu_3P and a sulphide Cu_2S. The latter is more resistant to acids than iron sulphide and may interfere with sulphur determination.

It seems possible that further researches on the effects of copper on gray cast iron may indicate a wider range of usefulness than is at present recognized.

References

1—Lupin—*Stahl und Eisen*, Vol. 20, pages 536-541, pages 558, 590, (1900).

2—Sahman—Zeitschrift fur Anorganische Chemie, Vol. 55, page 336, (1908).

3—Ruer and Goerens—*Ferrum*, Vol. 14, pages 49-61, (January 1917).

4—Smalley—*Foundry Trade Journal*, page 519 (1922); page 3, (1923).

5—Hamasumi—*Foundry Trade Journal*, Vol. 31, page 239, (1925); Vol. 32, page 71, (1925).

6—Michailoff—Mess of Metal Industry (Moscow), (1926).

7—Ishawara — *Scientific Reports* — Tohoku Imperial University, Vol. 15 Ser. 1, No. 1, (April 1926).

8—Piwowarsky and Kotzsche—*Archiv fur Eisenhuttenwesen*, No. 5, (1928).

9—Deneke—*Die Giesserei*, page 307, (1928).

10—Rolfe—*Journal*, Iron and Steel Institute, page 208, (1928).

11—Steinberg—*Journal* Society Chemical Industry, page 674, (1928).

12—Pfannenschmidt—*Die Giesserei*, page 179, (1929).

13—Hamasumi—*Scientific Reports*, Tohoku Imperial University, Vol. 13, pages 133-178 and *Die Giesserei*, No. 8, page 179, (1929).

14—Hurst—Iron and Steel Institute and British Foundryman, Vol. 5, No. 9, pages 319-324, (June 1932) and No. 10, pages 362-368, (July 1932).

15—Reed—*Transactions*, American Society for Steel Treating, Vol. 20, No. 2, pages 115-174, (August 1932).

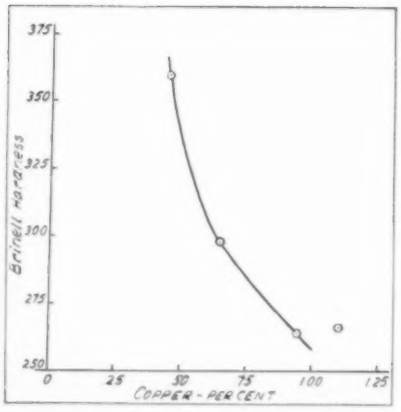

Fig. 92—Relation between brinell hardness and copper content of copper-chromium cast iron (0.60 per cent Cr. and 2 per cent Si.)

16—Taniguchi—Tetsu to Hagane Vol. 18, pages 952-980, (1932).

17—Long & MacLaren—*Alloys of Iron & Copper*—pages 272-273.

18—Eddy—*The Foundry*—February, 1934.

Pearlitic Malleable Cast Iron Is Discussed

Approximately 150 members and guests attended the dinner meeting sponsored by the Cleveland District committeee of the American Society for Testing Materials at the Cleveland club, Cleveland, on Monday evening Jan.27. Immediately following the dinner, Dr. Harry A. Schwartz, National Malleable & Steel Castings Co., Cleveland, chairman of the meeting, introduced H. S. Vassar, Public Service Electric & Gas Co., Irvington, N. J., and C. L. Warwick, Philadelphia, respectively president and secretary-treasurer of the A.S.T.M. who spoke on the work and aims of the society. Robert E. Kennedy, technical secretary, and Dan M. Avey, president, of the American Foundrymen's association spoke briefly stressing the co-operation between the A.F.A. and the A.S.T.M. Numerous other chairmen and active members of other interested organizations also were introduced to the group.

Following a brief intermission, Dr. Schwartz opened the technical session which comprised a symposium on pearlitic malleable cast iron prepared by the Cleveland District committee with co-operation of various producers of that material. The symposium was divided into three sections devoted to a discussion of what constitutes pearlitic malleable cast iron and the various structures that may be obtained; producers' data on manufacture and physical properties, and patents relating to the subject. Prof. H. M. Boylston, Case School of Applied Science, Cleveland, presented the first section while Dan M. Avey, editor, THE FOUNDRY, Cleveland, gave the second.

According to the symposium, pearlitic malleable cast iron is a product which starts out as white cast iron and subsequently is heat treated to produce graphitization if the graphitization be terminated purposely when sufficient combined carbon remains to affect significantly the properties of the product. Two major methods of production are interrupting graphitization before completion, and reheating completely graphitized alloys. The material may be produced in the air furnace, electric furnace and in the cupola. In general, it contains about 2.50 per cent total carbon, 1.50 per cent silicon, and 0.35 per cent manganese although in some types the manganese content ranges from 0.95 to 1.35 per cent.

Tensile strength of pearlitic malleable cast iron is dependent upon heat treatment which is controlled carefully, and ranges from 55,000 to 100,000 pounds and over per square inch. The elastic limit or yield point is about 75 per cent of the ultimate tensile strength, and the elongation varies inversely as the tensile strength, showing from 12 to 14 per cent elongation in two inches for the 55,000 pounds per square inch material and 3 to 4 per cent in the case of that having 100,000 pounds per square inch tensile strength. In addition to the chemical elements mentioned previously, nickel, chromium, molybdenum and vanadium sometimes are added to attain certain improvements in physical properties.

Requires Close Control

Following the presentation a number of those in attendance participated in the discussion including A. L. Boegehold, General Motors Research Laboratories, Detroit; C. H. Junge, National Malleable & Steel Castings Co., Cleveland; Duncan Forbes, Gunite Corp., Rockford, Ill.; E. E. Thum, *Metal Progress*, Cleveland; Harry Chandler, Vanadium Corp. of America, New York; Prof. Enrique Touceda, Malleable Iron Research institute, Albany, N. Y.; C. F. Burgess, Union Carbide & Carbon Corp., New York, and Gordon T. Williams, Cleveland Tractor Co., Cleveland.

Mr. Forbes pointed out that production of pearlitic malleable cast iron requires close control in composition and heat treatment to obtain uniformity of product and reproducible results. He also said that higher shrinkage and porosity are encountered so that larger gates and risers are necessary for sound castings. One member inquired on the application of the material as bearings for automotive use, but it was pointed out that pearlitic malleable is not suitable. Mr. Williams contributed some data on the tensile-impact properties of various materials including that under discussion. He said that a 35,000 pounds per square inch tensile strength cast iron showed 3 foot-pounds; a nickel-chromium cast iron, 5 foot-pounds; Z-metal, 56 foot-pounds, and plain carbon steel with 65,000 pounds per square inch tensile strength, 191 foot-pounds.

Founding Magnesium Alloys

(*Continued from page* 33)

that the metal in the pot remains semifluid. This low temperature operation practically eliminates any loss due to burning and gives maximum coalescence of the metal.

If the temperature were appreciably above the melting point of the metal many of the chips would melt into individual globules and coalescence would be hindered by the tenacious dirt film surrounding each globule and by the ease with which such globules glide by each other when stirred with the flux. Crystals in the semisolid globules puncture this film of flux and permit coalescence. When sufficient shavings have been added to fill the pot, the charge is stirred gently to complete coalescence and the temperature then raised to 1300 to 1350 degrees Fahr. for the regular puddling or washing operations. The pot contents now are allowed to stand quietly for a few minutes to permit the sludge to settle, whereupon the metal is cast into ingots or transferred to the casting pot.

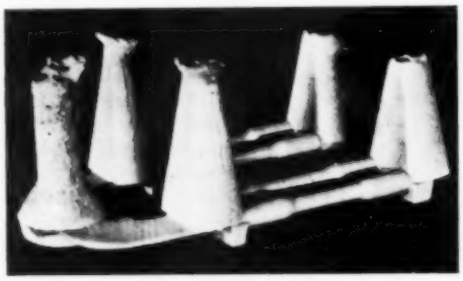

Fig. 5—Method of gating tension test specimen

If the melting and purification of scrap is conducted properly, the recovered magnesium alloy is equivalent to virgin metal. A comparison of the properties of virgin alloy and remelted scrap is shown in Table 1. One hundred pounds of virgin ingot were melted and about two-thirds of it cast into sand molds. These castings were then remelted and recast until the cycle had been repeated 15 times. Test specimens were poured from each heat, and the data shows that, within normal tolerance limits, the properties are constant throughout the entire run. On the other hand, if the remelted scrap is not properly washed with flux the oxide skins on the castings are not removed but soon accumulate to such an extent that they make the metal viscous and difficult to cast, and likewise reduce the strength of the metal. Contamination by foreign metals must be avoided carefully since many of these contain copper or nickel, two metals that are detrimental to magnesium from the standpoint of corrosion resistance.

Substantially all Dowmetal castings are now made from the magnesium-aluminum-manganese and magnesium - aluminum - manganese-zinc groups of alloys. Aluminum and zinc alloy so readily that hardeners and special technique are not required. Manganese alloys more slowly and only to a limited extent. It is generally added in the form of a 70-10 aluminum-manganese hardener. The casting alloys normally contain 0.2 to 0.4 per cent manganese but since this represents approximately the solubility limit, more time and stirring are required than when alloying other metals. A 75 to 80 per cent alloying efficiency for manganese is considered good operating practice. Most of the excess of unalloyed manganese settles to the bottom of the pot, although a few particles of microscopic size remain suspended in the alloy. The alloying ingredients are placed in the ladle and then submerged and gently agitated in the molten magnesium, after which the entire charge is thoroughly stirred.

The aluminum content of magnesium-aluminum-manganese alloys and of the magnesium-aluminum-manganese-zinc alloys, before the introduction of the zinc, can be controlled with sufficient accuracy for most commercial work by determining the Rockwell hardness of specially prepared samples. The metal is cast into a preheated graphite mold as illustrated in Fig. 4. Samples ½-inch long are cut from the center of the two middle ½-inch square bars and polished on both ends, finishing with 150 emery cloth.

Rockwell E hardness readings then are made on each surface about

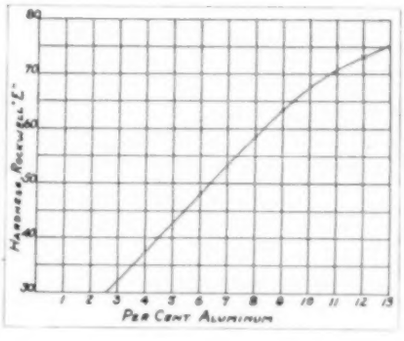

Fig. 6—Chart showing relation between Rockwell E hardness and per cent of aluminum in magnesium-aluminum-manganese alloys

⅛-inch from the corners of the specimen. Readings are rejected if they are two or more points removed from any of the other values, and a new sample is run if three or more readings are rejected on a single specimen. The average Rockwell E hardness value then is used for the determination of the percentage of aluminum from the graph shown in Fig. 6. The aluminum content thus obtained is usually correct to ± 0.3 per cent. This procedure is helpful, particularly when melting scrap from alloys containing different amounts of aluminum. It constitutes a quick method for determining the amounts of the different ingredients required to bring the molten charge to the desired composition. After casting into ingots, the metal can be analyzed by standard chemical methods if more accurate data are required.

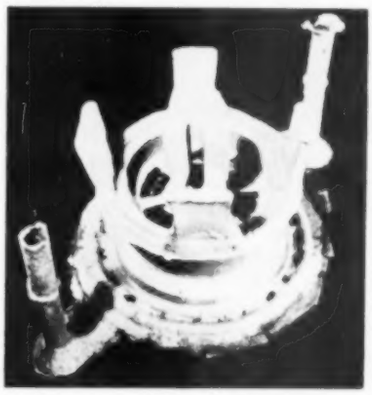

Fig. 7—Casting with gates and risers attached

Casting of magnesium in green sand molds became practical with the discovery of methods for protecting the hot metal from attack by water vapor. This action is so vigorous in ordinary wet sand that the surface and sometimes the entire cross-section of the castings are badly oxidized. Such burning can be overcome completely, by incorporating in the sand substances that are oxidized more readily than the magnesium itself or that form a protective gas blanket around the metal. These materials are commonly known as sand addition agents and include sulphur, boric acid, and certain ammonium salts, particularly the fluorides. The amount used depends upon the agent selected, the permeability and moisture content of the sand, and the thickness of the cast section. Some foundries prefer simple mixtures of sulphur and boric acid, while others employ ammonium fluoride salts, alone or mixed with sulphur and boric acid. The heap becomes depleted on continuous use so that fresh additions are made from time to time as required

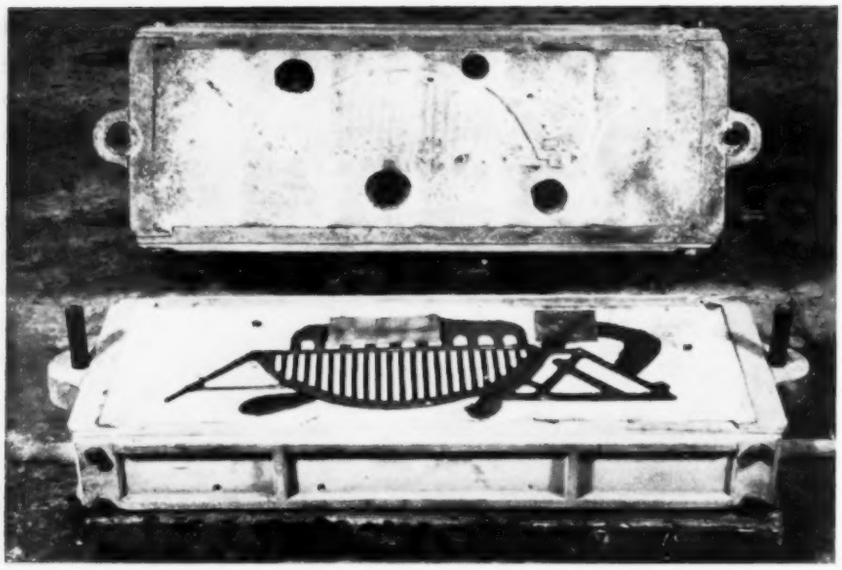

Fig. 8—Open mold for magnesium alloy casting showing gating methods and skimmers in the gate in place

to prevent burning. With heavy castings or sand of relatively low permeability, it is sometimes advantageous to use a facing containing more of the agent, to dust the molds with finely powdered sulphur, or to surface dry the mold; otherwise, special facings and washes are not required.

An open molding sand should be used to offset the lightness of the metal and allow the gas to escape readily. Very satisfactory results now are being obtained from a synthetic sand with an A.F.A. permeability of 50 to 60, obtained by adding 4 per cent bentonite to a silica sand graded to a 100 to 150 mesh. A 75-25 water-glycol mixture is used as the tempering agent. Glycol functions much the same as water in developing the molding characteristics of sand and, hence, lowers the actual water content of the tempered sand. It likewise exerts some protective action towards the magnesium and because of its high boiling point prevents rapid drying out of the sand on the surface of the heap. In practice, the glycol is added to the sand and the tempering completed by the addition of the requisite amount of water. Thorough mulling of the sand is essential to insure uniform distribution of the bentonite, glycol, and sand addition agent and to improve the strength and plasticity of the sand.

The sand should not be hard-rammed close to the pattern; but as one proceeds away from the pattern, the ramming can be increased to insure safe handling of the mold without danger of drops. Light ramming improves the permeability of the sand and permits its contraction during the solidification and cooling of the castings. This contractability in both molds and cores is desirable to counteract hot-shortness in the alloys and so minimize the danger of shrinkage cracks. The mold should likewise be vented freely to aid in the escape of gases.

Although gating practice varies necessarily from casting to casting, there are a number of fundamental principles that must be observed. The metal should, in general, enter the mold cavity at a low point with a minimum of splashing or turbulence, since mechanically entrapped gas forms oxide skins in the metal and these, in turn, increase the viscosity of the metal and retard any subsequent escape of gas. However, it is advisable in some cases, to enter the metal at the center or top providing the mold cavity has an incline to break the velocity, and is without elevations and depressions that will create a turbulence before the metal reaches the bottom. This procedure often results in a more uniform solidification of the casting, thus helping to eliminate shrinks, cracks porous sections, and in some cases misruns.

Turbulence, with its resulting evils, is largely overcome through the use of perforated sheet-metal skim-gates containing eight or 12 perforations per inch. This screen is placed at the bottom of the sprue, and, in large complicated castings, a second screen sometimes is placed in the runner near the gates. These screens choke the flow of metal, thereby assuring a steady feed into the mold cavity, and they likewise trap oxide skins that form on the surface of the metal during the pouring operations. Fig. 8 shows a mold just prior to closing with the screen in place. Wedge gates that are wide and shallow and feed from the bottom of a hump or wall likewise aid in the removal of entrapped air and oxide skins but are less frequently used now that skim gates are employed so generally.

A number of finger gates are preferable to fewer large ones as they give a better distribution of heat in the casting and also prevent local overheating of the sand and generation of excess gas and water vapor. Similar objectives call for the location of gates on the thinner sections of the castings. Although the specific heat of the metal is high (0.33 average specific heat 70 to 1200 degrees Fahr.), the gravity of the metal is low, with the result that the total heat per unit volume also is low. As a result, gates and runners should be of generous proportions to insure a free flow of metal, and risers should be large and connected as directly as possible to the section to be fed. Fig. 7 shows a casting with gates and risers attached and Fig. 5 shows the method of gating tension test specimen.

Progressive solidification of the metal should be obtained through the use of risers instead of chills whereever the riser will accomplish the same end, and provided it is located so that it does not introduce trouble in molding and trimming. When chills are used, they may be made from customary materials, such as iron and graphite, although best results are obtained from magnesium alloy chills. The chills must be clean and dry to avoid blows, and large chills should be perforated.

A shrinkage factor of 3/16-inch per ft. used for Dowmetal castings of moderate size or with unrestricted

(*Concluded on page* 94)

Table I

Effect of Remelting Dowmetal A

Melt Number	Tensile Strength lb. per sq. in.	Elongation Per Cent	Impact* Dow No.
Orig.	26,500	5.9	5.8
5	26,900	6.1	4.5
10	27,400	6.5	5.2
15	26,500	6.0	4.6
Avg. 1-15	26,900	6.0	4.9

*Dow impact numbers represent ft.-lb. of energy absorbed in breaking a ½ in. square specimen with a ⅛ in. deep notch cut on a 1/16 in. radius. These values are approximately twice the standard Izod impact numbers.

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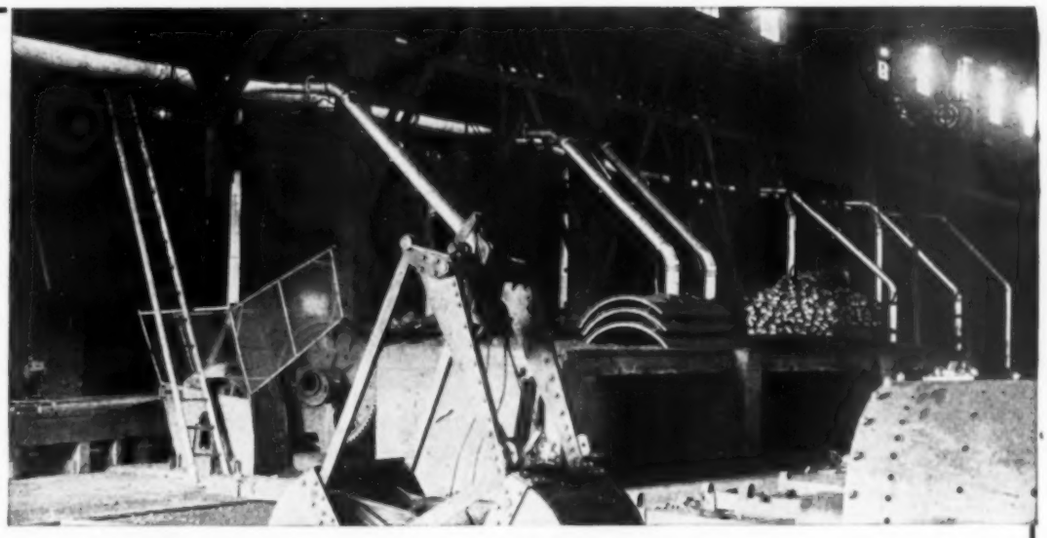

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(*Concluded from page* 92)

shrinkage. A shrinkage factor of 5/32 inch per ft. is advisable on large castings or where free shrinkage is prevented by bosses or internal cores. As these values compare closely with the shrinkage values for aluminum alloys, equipment designed for aluminum can be used in a majority of cases. Generous fillets should be used where the gate joins the casting and where thin sections join heavy sections.

Cores should be made from an open sand containing sulphur, boric acid, and an oil binder. They should be rammed no harder than necessary to insure retaining their shape before baking, and should be well vented. The oil binder should generate a minimum of gas and should permit the core to soften when contacted by molten metal. The cores are baked at 350 to 500 degrees Fahr. for 20 minutes to several hours, depending on the size of the core, after which they are given a graphite-alcohol wash and the alcohol ignited and burned off.

Green sand cores should be used wherever possible for smoothness and economy. They are made from the regular heap used for the production of molds.

The second and final installment of this article will appear in an early issue.

THE EDITORS

California Group Honors Oldest Member

John Hedley, for many years recognized as the dean of San Francisco foundrymen, recently was elected honorary member of the Northern California Chapter of the American Foundrymen's association. Mr. Hedley was born in Preston, England, Feb. 25, 1849, member of a family of mechanics for many generations. His father was an exceptional molder and a great uncle, William Hedley, in 1813 designed and built the *Puffing Billy*, the first successfully operated steam locomotive in the world. In 1856 his family moved to Ballarat, Australia, where at the age of 12, John commenced his apprenticeship in the foundry. In 1870 he moved to San Francisco and secured employment in the old Union Iron Works, now the Union plant of the Bethlehem Shipbuilding Corp. He became foreman loam molder in 1873 when the company was building machinery for the Comstock Lode in Nevada.

In 1880 he was appointed foreman in the foundry of W. T. Garrat Co., and in 1885 he accepted a similar position with Steiger & Kerr. While in this shop he made the cores and molds for the first water jacketed gas engine cylinder blocks cast in California. He formed a partnership with Thomas Morton in 1891 and started the Western Foundry. The plant was destroyed by fire in 1927. From that time until his retirement in 1933 after 71 years of continued foundry activity Mr. Hedley was superintendent in the Joshua Hendy Iron Works. He now resides at Decoto, Calif. Mr. Hedley is a bachelor and in his youth was an accomplished musician who played in the symphony concert for many years.

Foundry Practice

WITH applications for magnesium castings growing constantly, much of interest should be found in this article on the founding of that light metal. This article, which is the first of two, is from a paper presented at the recent Toronto convention of the American Foundrymen's association. Dr. Gann is chief metallurgist and Mr. Brooks is metallurgist, Dow Chemical Co., Midland, Mich.

The second and final installment will appear in the February issue of The Foundry.

Progress Points to Greater Use of Castings

The probable future trend in motor car construction which predicts a greater use of cast metals, was presented in the *Cleveland Plain Dealer*, Jan. 26, as follows:

Experimental work of the Ford Motor Co., on which millions of dollars have been spent, is being reflected in the development of new and better materials for the Ford V-8, according to C. J. Seyffer, manager of the Cleveland Ford branch.

If there is a trend in the Ford experimental work, it is toward the more extensive use of cast metals wherever they can be evolved of suitable quality and characteristics. The cast alloy steel crankshaft, the alloy iron valve lifters and the alloy iron camshaft of the Ford V-8 engine are notable examples. These exclusive Ford developments are in use on more than a million vehicles, and are giving better results than the conventional forgings they replaced, service records of the company show.

"When we talk about castings today," said Seyffer, "we are referring to entirely different metals than were considered suitable for pouring into cast form a few years ago. The Ford Motor Co. has been pioneering in a new field, the creation of iron alloys heretofore not used or even thought commercially feasible. These new alloys possess strength and toughness far superior to the cast irons and cast steels of a decade or more ago.

"Ford castings are of new metals that are really new. New mixtures of metals, new alloys or different quantities of alloying metals are being developed, and these are melted, poured, cooled and heat-treated in new ways, so that they are in fact new materials."

Engineers To Hear Papers on Cast Metals

For the second time, the Chicago Chapter of American Foundrymen's association, the Chicago Section of American Society of Mechanical Engineers, and the Western Society of Engineers are co-operating in a joint meeting to present engineering data on cast metals to the engineers of the Chicago area. A meeting of a similar character was held during the past year at which the attendance was over 500 and considerable interest evidenced.

The meeting will be held in the auditorium of the Engineering Building, 205 West Wacker drive, Chicago, on March 16, and all engineers are cordially invited to attend. Speakers will be George M. Zabel, foundry superintendent, Fairbanks Morse & Co., Beloit, Wis., who will speak on "Engineering in Its Relation to the Foundry," and G. P. Phillips, metallurgist, gas power engineering department, International Harvester Co., Chicago, whose subject will be "Selection and Use of Cast Metals for Machine Parts."

Mr. Zabel's talk will stress the importance of designing castings for production and will show how changes in design have made possible more economical production and an improvement in the physical properties of castings. Mr. Phillips will deal with the factors that must be taken into consideration when selecting materials for castings.

The committee which has charge of the meeting is under the chairmanship of R. D. Brizzolara, chief engineer, American Steel Foundries, Chicago. The committee is planning to have a two-day exhibit of castings in connection with the meeting. Castings shown will be of special interest to the designer and purchaser of cast parts.

Bulletin Discusses Superheating of Iron

Michigan Engineering Experiment station, East Lansing, Mich., has published a bulletin on "The Properties of Gray Iron Castings as Effected by Superheating Temperatures," by M. F. Surls and Frederick G. Sefing. The report is the result of a study conducted under the direction of the authors at Michigan State College.

The bulletin may be secured from the experiment station for 25 cents.

ADVERTISING PAGES OMITTED

Obituary

JOHN W. SMITH, 53, superintendent of the foundry and pattern shop, Builders Iron Foundry, Providence, R. I., died recently. He was born in New York in 1882. He served his time as a pattern maker with Beaman & Smith, Providence, until 1903 when he became connected with the Builders Iron Foundry in the same capacity. Later he was promoted to foreman of the pattern shop, a position he held for 12 years. In 1919 he was advanced to the position of superintendent of foundry and pattern shop, which position he held at the time of his death. His friendly personality and his willingness to discuss foundry problems freely with all interested, earned for him an affectionate regard of all with whom he came in contact.

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Edward P. Brennan, secretary and treasurer, New Haven Malleable Iron Co., New Haven, Conn., died Dec. 29.

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Edward H. Headford, president, Headford Bros. & Hitchins Foundry Co., Waterloo, Iowa, died in Waterloo, Jan. 21.

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William J. Piersen, 53, recently western sales manager, Adams & Westlake Co., Elkhart, Ind., died in Evanston, Ill., Jan. 12.

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Charles W. Gray, 80, formerly southern sales manager, United States Pipe & Foundry Co., Birmingham, Ala., died Jan. 27. He retired from active business ten years ago.

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John J. Miller, 77, one of the founders and secretary of the Loeffelholz Co., Milwaukee, makers of brass castings and railroad supplies, died recently. He was a native of Milwaukee.

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Oliver W. Brost, 54, for 20 years secretary-treasurer of the Brost Pattern & Casting Co., Cleveland, died recently. Mr. Brost joined the firm started by his brother, Jay V. Brost.

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Julius L. Kipp, 65, president, Waterbury Iron Works, and treasurer of the Waterbury Foundry Co., Waterbury, Conn., died in that city Jan. 9. A native of Germany, Mr. Kipp had been a manufacturer in Waterbury for 22 years.

• • •

Frederick Freeman Newcomb, 59, died recently. He was born in Worcester, Mass. and attended public schools in that city, English high school and Becker's Business college. He first was connected with his uncle, Col. J. Horton of Buffalo in the coal business and then Charles Dennison of New York. Later he became affiliated with Rogers, Brown & Co.; Sam Baird and Mr. Dette of New York; Pilling & Co.; and prior to his death was in business for himself and a representative of the E. & G. Brooke Iron Co., Philadelphia. Mr. Newcomb was a member of the New England Foundrymen's association.

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D. T. Sipe, 60, president, Brighton Electric Steel Casting Co., Beaver Falls, Pa., died Jan. 23 from a heart attack. He was one of the organizers of the present Vanadium-Alloys Steel Co. Latrobe, Pa., and the Braeburn Alloy Steel Corp., Braeburn, Pa. He was well known as a coal operator and at the time of his death was a director of the Vanadium-Alloys Steel Co.

• • •

Alexander England, 69, retired chief engineer of Westinghouse Air Brake Co., Wilmerding, Pa., died at Wilkinsburg, Pa., Jan. 30. He was born in Dundee, Scotland, graduated in engineering from the City and Guilds of London Technical Institute, England, and after service with the Mercantile Steamship Co., London, came to United States in 1887. He settled in Pittsburgh where he became assistant superintendent of Thomas Carlin's Sons, manufacturers of hoisting engines and brick plant machinery. When this firm was merged with the Specialty Mfg. Co., he was made superintendent. Several years later Mr. England was employed by Jones & Laughlin Steel Corp. to assist in the reconstruction of the Eliza furnace division as engineer in charge of design for special machinery and equipment for the handling of coal and coke. He went with Westinghouse Air Brake Co. in 1898, in 1914 was made assistant chief engineer and in 1921 became chief engineer. He retired Jan. 1, 1933.

A.S.T.M. Publishes Index To Its Standards

American Society for Testing Materials, 260 South Broad street, Philadelphia, has published an index to A. S. T. M. standards and tentative standards. The index is designed to assist in ascertaining whether the Society has issued standard specifications or test methods, in particular engineering materials or subjects. It also aids in locating easily any of the standards in the publication. The latest edition of the index gives information on all of the 794 A.S.T.M. standards and tentative standards, as of Jan. 1, 1936.

Copies may be secured without charge from the headquarters of the society.

N. E. Ohio Chapter Hears Talk on Patterns

Approximately 150 members and guests of the North Eastern Ohio chapter of the American Foundrymen's association heard Vaughan Reid, president of the City Pattern Works and also chairman of the Detroit chapter of the A.F.A. deliver an address on patterns and pattern making at the Cleveland club, Cleveland, Jan. 16. The guests included 18 foundry and pattern shop students from the Cleveland Trade school. Following the dinner Lincoln C. Dickey, manager of the project, outlined the plans and prospects of the Great Lakes exposition to be held in Cleveland from the latter part of June to the end of September. The meeting was conducted by Frank G. Steinebach, managing editor of THE FOUNDRY and vice chairman of the North Eastern Ohio chapter of the A.F.A.

Starting with the premise that a pattern is a production tool for the foundry, Mr. Reid stressed the fact that materials and workmanship must be of the highest class. Lumber should be held in the shop for at least a month before it is converted into a pattern. Humidity of the shop should be held to a uniform degree. Glue deteriorates rapidly when exposed and the same holds with shellac. These materials should be prepared in small quantities and used immediately.

The speaker holds decided views on the composition and method of manipulating aluminum for patterns. In his plant only virgin metals are employed, an alloy of aluminimum 92 per cent, silicon 3 per cent and copper 5 per cent. The metal is melted and cast into ingots and then remelted for pattern use. To prevent oxidation of the metal and subsequent pin holes in the castings the metal is poured directly from the melting pot into the mold.

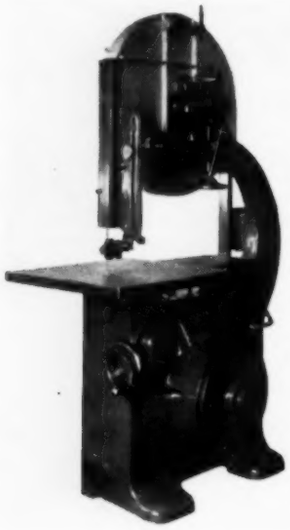
All iron and aluminum pattern castings are annealed or normalized before they are machined. Aluminum castings are held at a temperature of 550 degrees for 6 hours. Steel inserts are placed at the points of greatest wear in aluminum patterns and coreboxes. The speaker instanced one prominent automobile plant in which all iron patterns are chrome plated to increase wear resistance. Deposit of chromium is 0.005-inch thick. An animated discussion followed the formal presentation.

Link-Belt Co., Chicago, has moved its St. Louis sales office from 3637 Olive street to 1018-21 Louderman building, 317 North Eleventh street, St. Louis. Howard L. Purdon is district sales manager.

NEW EQUIPMENT . . . . for foundries

Band Saw Machine Has Moving Parts Guarded

Oliver Machinery Co., Grand Rapids, Mich., recently has introduced a band sawing machine shown in the accompanying illustration and presenting new features. Briefly these include an automatic brake for the upper wheel, complete guarding device over all moving parts, enclosed



The drive unit is located in a circular opening in the base of the machine

oil immersed self locking tilting device for the table, a tension indicator, a foot brake which shuts off the current and stops the machine quickly, a dust collecting system, and other features.

The frame is a one piece iron casting, strong, durable and free from vibration at any speed of the saw. Wheels are of one piece disk type accurately machined and balanced. Upper wheel is aluminum, lower wheel cast iron, faced with rubber bands and secured to the wheel shafts on tapered ball bearings. All major parts are interchangeable. Either the built in motor-on-shaft unit or the belt driven lower spindle unit may be located in a finished circular opening in the base. The unit fits tightly and is locked in place when in use, yet readily may be removed as a whole either for examination or replacement. The machine is supplied for any type of drive desired, belted, geared, coupled, silent chain, motor hung at back or the type shown, fully enclosed, built in motor-on-shaft drive.

Saw blade runs in a fully enclosed metal guard at back of machine, and is guarded at front by U-shaped guard attached to the guide post and an adjustable shutter guard which can be set close to the work.

Resistor Type Rocking Electric Furnace

Detroit Electric Furnace Co., 825 Elizabeth street, Detroit announces the preliminary test and manufacture of a resistor type rocking furnace. It is claimed that this unit will be especially useful for low temperature melting operations and may have special value in the chemical field. The broad principles of the furnace are old. The rocking mechanism and control are similar to those on earlier models. A resistor element has been adapted by mounting a graphite resistor on the central axis of the furnace and connecting it to a special transformer to secure unusual temperature and control. It is stated that equipment of this type has been built and is being tested. In the event that it meets all expectations, several sizes will be available.

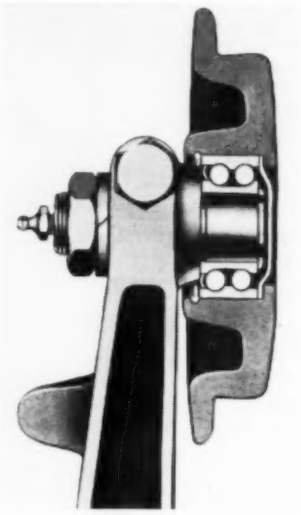
Air Hose Resists Effects of Hot Oil

Republic Rubber Co., Youngstown, O., has introduced a new air hose, designed especially to overcome the deteriorating effects of hot oil from air compressors. The tube is made from a compound similar to that used in oil conducting hose and can be saturated with oil for long periods of time without affecting its serviceability.

The hose also has great resistance to heat, high pressures, abrasion, cutting effect of sharp rock and exposure to sun and weather. Greater strength has been obtained without impairing flexibility by constructing the plies from a specially twisted cord which is thoroughly impregnated with a new tenacious rubber compound.

Develops a New Style of Trolley Wheel

Osborn Mfg. Co., 5401 Hamilton avenue, Cleveland recently has developed a trolley wheel of improved design as shown in the accompanying illustration. The wheel, made to a special analysis showing high strength, is an iron casting with deep chilled tread and flange insuring a



Sectional view of wheel showing shielded type ball bearing

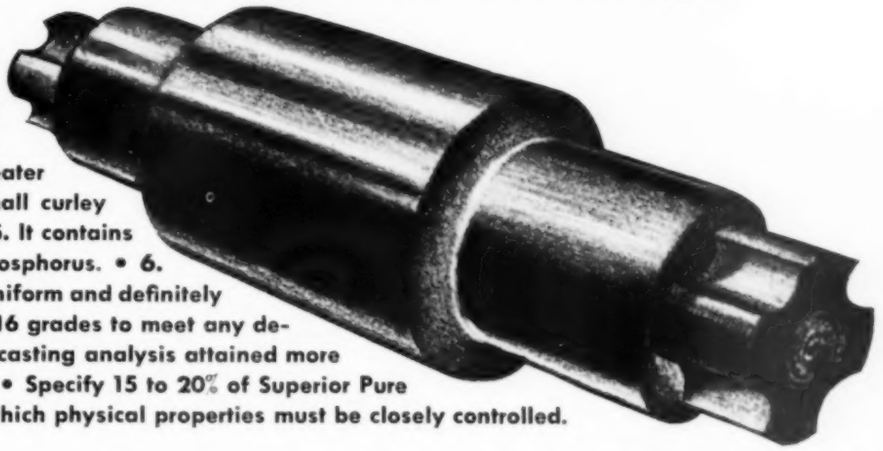
hard, smooth long wearing surface. Slight crown on the tread brings the wear on the rail flange in from the outside. The straight flange is a factor in reducing rolling friction. The double row shielded type ball bearing assembled complete by the bearing manufacturer provides extreme accuracy of the bearing in the wheel. The completely dust protected bearing is grease lubricated and the assembly may be taken apart for inspection and cleaning. It is claimed that a trolley equipped with these wheels has an exceptionally low draw bar pull.

Appoints Dealer Agent

Bird-Archer Co., Philadelphia, has been appointed dealer agent of the General Refractories Co. in the Philadelphia area, and will carry a complete stock of refractories.

Superior PURE CHARCOAL PIG IRON

for better castings



The reasons for the use of Pure Charcoal Pig Iron in the cupola charge are very direct and very logical. They are: 1. It is 25% stronger in transverse strength than other types of unalloyed pig. • 2. It is 30% stronger in tensile strength. • 3. It has closer grain structure and greater density. • 4. Its graphite is in small curley modules instead of large flakes. • 5. It contains less oxides, less sulphur and less phosphorus. • 6. Its economical analysis is far more uniform and definitely dependable. • 7. It is available in 16 grades to meet any desired requirements. • 8. Control of casting analysis attained more cheaply than by any other method. • Specify 15 to 20% of Superior Pure Charcoal Pig Iron for every run in which physical properties must be closely controlled.

SUPERIOR CHARCOAL IRON COMPANY

GRAND RAPIDS, MICH. — **DEBEVOISE-ANDERSON CO., INC., Eastern Representative**

NEW YORK • BOSTON • PHILADELPHIA

OVER 40 YEARS

of Service In The Foundry Field

• It is a fine testimonial to the uniform quality of our products and efficiency of our service that customers of more than forty years standing are still obtaining all their fire clay requirements from us.

Prompt shipments in mixed carloads, if desired.

• Fine Ground and Rolled Flake for Cupola and Ladle Lining and for all furnace uses.

• Specially prepared high grade pulverized Black Horse brand Fire Clay for facing, bonding and laying fire brick.

If you have never used West Virginia Fire Clay—send us your inquiry.

WEST VIRGINIA FIRE CLAY MANUFACTURING CO.

Diamond Bank Building
PITTSBURGH, PA.

BRANFORD VIBRATORS

Vibrator Flask Rapper (above)

Vibrators for all foundry uses

The New Haven Vibrator Co., Inc.
10 Stiles Street

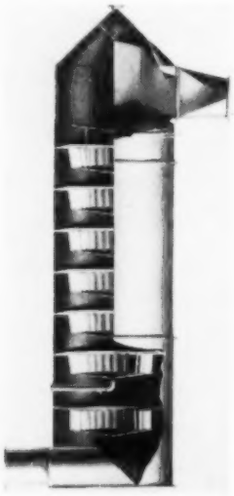
P. O. Box 1669 — Phone—New Haven 4-1444

New Haven, Conn.

The above company has acquired by purchase from **The Malleable Iron Fittings Co.** their line of **Branford Vibrators and Accessories** and will continue the same prompt deliveries and the same high quality of goods.

Wet Dust Collector Tower Has New Features

Changes in design of its line of wet dust collectors have been announced by the Claude B. Schneible Co., 3951 Lawrence avenue, Chicago. The wet collector tower, shown in the accompanying illustration, similar in external appearance to former models, now is made with



New type dust collector tower shows several improved features

six dust impingement plates. The seventh of the series is designed for use as a water entrainment separator to gather the remaining moisture from the clean air before it is exhausted.

Other major design changes include a dirty air baffle under the first impingement plate, wearing strip reinforcing, an air directional baffle on the inlet side in the cyclone chamber, and a screened strainer on the sludge discharge line.

The new tower has been designed to better cope with dust hazard conditions in foundries and other industrial plants.

Absorbs Fumes And Moisture from Air

Motor Improvements Inc., 365 Frelinghuysen avenue, Newark, N. J., has introduced a new Purolator air separator for absorbing fumes of overheated oil as well as removing oil and water moisture from the air that is to be used in the mask of a sandblast operator.

The new air separator has a filtering element of brass and a special alloy of bronze enclosed in a metal case. The element surface is made of a special alloy bronze ribbon, wedge-shaped in cross sections, and having rises 0.0005-inch high placed at intervals of ⅛-inch on one side of the ribbon. The other side is smooth. This ribbon is wound in a spiral around a brass cylinder having fluted sides in such a way that the ribbon, standing on edge and being held apart by the rises, forms a series of slots each with a width of 0.0005-inch and a length of approximately ⅛-inch.

Compressed air enters the separator case, striking the inside walls of the case and the external surface of the filtering element. These parts act as baffles and some oil and water is at once removed and drops to the sump in the bottom of the container. The greater part of the separation takes place while the air is passing through the filtering slots in the filtering element. There are 26,766 slots whose sharp edges shear from the tiny stream passing through it minute and even microscopical drops of oil and water. It is claimed that such small amounts as might be pushed through the slots adhere to the metal because of surface tension and attraction for the metal and fall to the sump.

The space within the body cylinder is filled with approximately ½-pound of activated carbon and a 60-mesh screen and wool cap is placed on top of the cylinder to prevent the entrance into the air line of particles of carbon. It is the carbon which absorbs the dangerous fumes in the air. The filtering unit may be removed for such refilling as well as cleaning.

Designs Small Reciprocating Pump

Homestead Valve Mfg. Co. Inc., Coraopolis, Pa., has developed a miniature triplex plunger reciprocating pump which has a capacity varying from 15 to 120 gallons per hour, depending upon the speed of operation. Power required by the pump is small, such that a ¼-horsepower electric motor will operate the pump at 60 gallons per hour capacity and 200 pounds pressure. The unit is a single acting plunger type having three cylinders of ¾-inch bore and ⅝-inch stroke with the plungers attached to the crosshead guides which are driven by connecting rods from the crankshaft. Monel metal inlet valves are of the poppet type, positively actuated through a cam and tappet mechanism, and the outlet check valves are of the ball type with adjustable limited lift for high-speed operation. The unit is adaptable to a wide variety of uses.

Forms Canadian Firm

Western Precipitation Co., Los Angeles, has formed a Canadian company known as the Precipitation Co. of Canada, Ltd., with offices at Dominion square, 1010 St. Catherine street, West, Montreal, Quebec.

Introduces Device To Reduce Vibration

Strength, compactness and a high degree of vibration isolation for light and medium weight machinery are claimed for a device manufactured in various sizes by the Korfund Co., 48 Thirty-second place, Long Island City, N. Y. In the type shown in the accompanying illustration the machine is

The angle irons are connected firmly by bolts

supported directly by a *T*-iron separated from the base of two angle irons by natural cork or other isolating material. The angle irons are connected firmly by bolts passing through the isolating material and *T*-iron, but not touching it.

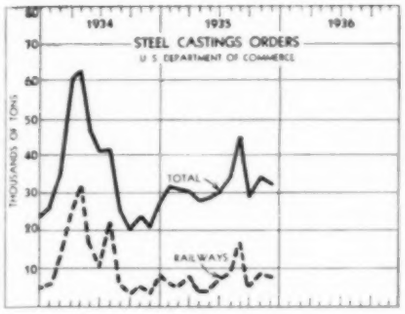
Before installation these bolts are adjusted to produce a precompression of the isolating material to suit the machine load. Further adjustment easily can be made after installation. Where the machine frame is light or must be supported at several points, the *T*-iron can be extended to form a continuous support between two or more of the vibration absorbing units thus eliminating undue bending strains in the machine frame.

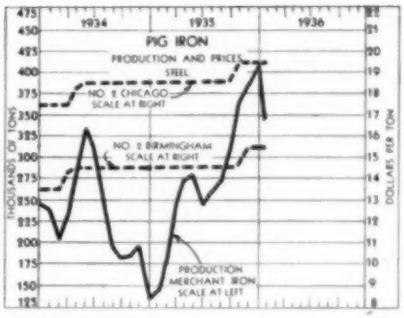
Develops Paint To Be Handled in Sticks

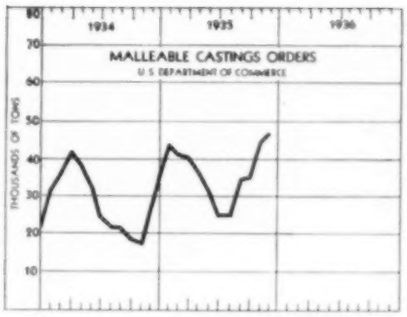
Paint in stick form for wet or dry surfaces recently has been placed on the market by Helmer & Stanley, South Parkway, Chicago. The paint is available in two grades, one for hot and one for cold marking. It is claimed that the paint for hot marking may be applied to any material at temperatures ranging from 300 to 1200 degrees Fahr. When the stick becomes short it may be heat welded to the end of a new stick. A simple and convenient holder is available for the protection of the operator's hands.

Welding Rod

Linde Air Products Co., 30 East Forty-second street, New York, has introduced a new stainless steel welding rod for welding chrome-nickel steels of the 18-8 type. A feature of the rod is the inclusion of a definite quantity of columbium. No special technique is necessary in the use of the new rod.







Foundry Activities

Reflect Industrial Trends

EASTERN MALLEABLE IRON CO., Naugatuck, Conn., has taken over the properties including plant, equipment, and personnel of the Eberhard Mfg. Co., Cleveland. This plant will be operated as the Eberhard division of the Eastern Malleable Iron Co. and with no change of personnel. The Eastern Co. in addition to its Naugatuck division also operates plants at New Britain and Wilmington, Del.

♦ ♦ ♦

Lancaster Iron Works, Lancaster, Pa., recently suffered $100,000 loss by fire at its main plant.

♦ ♦ ♦

Frank J. Novak Foundry Co., Detroit, has been incorporated for the manufacture of pattern castings by Frank J. Novak.

♦ ♦ ♦

Lorain Casting Co., Lorain, O., recently sustained a loss of approximately $3500 due to fire which originated in the boiler room.

♦ ♦ ♦

Portland Forge & Foundry Co., Portland, Ind., recently sustained damage to its machine shop approximated at $1000.

♦ ♦ ♦

Union Iron Foundry, Union, S. C., recently sustained a $35,000 loss by fire. J. M. Moss is president of the firm.

♦ ♦ ♦

Permit has been granted for a warehouse to be constructed for the Harper Foundry & Machine Co., Jackson, Miss., according to a recent report.

♦ ♦ ♦

Index of foundry equipment orders for December, according to a report of the Foundry Equipment Manufacturers' association, Cleveland, was 118.1 as compared with 99.8 for November, and 66.9 for December of the previous year. Index of shipments was 147.6 as compared with 145.2 in November and 81.1 in December, 1934.

♦ ♦ ♦

Lufkin Foundry & Machine Co., Lufkin, Tex., recently received a permit for a new structure at $19,000, the largest permit for the year in that city.

♦ ♦ ♦

Receivership of the Homer Furnace & Foundry Corp., Coldwater, Mich., recently has been terminated, the corporation being in a sound financial position and plant running at capacity. Arrangements have been made for Mr. Carlyle, the receiver, to continue on as manager of the corporation and business continue on the same basis and policies pursued for the past several years.

♦ ♦ ♦

Announcement has been made of the $200,000 expansion program for the Pottstown, Pa., plant of the Doehler Die Casting Co. The plant is to be rebuilt and remodeled.

♦ ♦ ♦

Unit Stove & Furnace Co., Birmingham, Ala., reports active business and high output and expects to maintain steady operation for an indefinite period.

♦ ♦ ♦

Milfound Co., Waupun, Wis., recently has let a contract for a new foundry to replace the building previously destroyed by fire. It is to be a one-story fire proof structure.

♦ ♦ ♦

Stroh Die Moulded Castings Co., 525 East Michigan street, Milwaukee, has been incorporated by Donald Stroh, Arthur L. Bach and H. M. Blume.

♦ ♦ ♦

A record for the production of aluminum castings goes to the foundries of the Bohn Aluminum & Brass Corp., Detroit, which produced over 40,000,000 pounds of aluminum castings during 1935.

♦ ♦ ♦

Electric Steel Foundry Inc., Portland, Ore., has constructed a frame building at Northwest Twenty-fourth avenue and York street, which contains plant offices, pattern storage, lockers, showers and club rooms.

♦ ♦ ♦

Output of gray iron and steel castings in the Philadelphia federal reserve district increased during December, according to reports received by the Industrial Research depart-

RAW MATERIAL PRICES
Feb. 3, 1936

Iron	
No. 2 foundry, Valley	$19.50
No. 2 Southern, Birmingham	15.50
No. 2 foundry, Chicago	19.50
No. 2 foundry, Buffalo	19.50
Basic, Buffalo	18.50
Basic, Valley	19.00
Malleable, Chicago	19.50
Malleable, Buffalo	20.00
Charcoal iron, furnace	22.00
Coke	
Connellsville beehive premium	$5.50 to $5.75
Wise county beehive coke	4.50 to 5.00
Detroit by-product coke	9.00
Scrap	
Heavy melting steel, Valley	$14.50 to $15.00
Heavy melting steel, Pitts.(dlv.)	14.25 to 14.75
Heavy melting steel, Chicago	13.25 to 13.75
Stove plate, Buffalo	10.50 to 11.00
Stove plate, Chicago	7.50 to 8.00
No. 1 cast, New York	9.50 to 10.00
No. 1 cast, mchy., Chicago	12.00 to 12.50
No. 1 cast, Pittsburgh	13.50 to 14.00
No. 1 cast, Philadelphia	12.50 to 13.00
No. 1 cast, Birmingham	11.00 to 12.00
Car wheels, iron, Pittsburgh	14.25 to 14.75
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	16.00 to 16.50
Malleable, Buffalo	15.00 to 15.50
Nonferrous Metals	**Cents per pound**
Castings copper, refinery	8.85 to 8.95
Straits tin	48.12½
Aluminum, 99 per cent	19.00 to 21.00
Aluminum, No. 12 (Secondary, standard)	17.00 to 17.50
Lead, New York	4.50
Antimony, New York	12.87½
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.85

ment, University of Pennsylvania. Production of gray iron castings during December was 2.2 per cent more than in the previous month, which is the largest increase reported for the corresponding period of preceding years except in 1932. Total output of malleable iron castings in December was 22.5 per cent above the average of 1926. Output of steel castings during December was 43.0 per cent more than in the previous month, this increase being confined to castings for jobbing work.

♦ ♦ ♦

Gilpen Foundry Co. Inc., 1250 East Gilbert street, Muncie, Ind., recently has been opened for the production of gray iron and aluminum castings of all kinds. Bottle molds are at present the principal product.

♦ ♦ ♦

United Engineering & Foundry Co., Pittsburgh, reports that it is acquiring the Wooster, O., plant of the Mackintosh-Hemphill Co., expecting to take over the plant with rolling mill making equipment as soon as possible and go into active production.

♦ ♦ ♦

Interlake Iron Corp., Toledo, O., has announced that work has begun on the construction of its new plant to be used for the production of cast iron paving plates. Possible further expansion might be expected, according to E. J. Clair, general manager. The castings will be produced in permanent molds.

♦ ♦ ♦

Newman Bros. Inc., Cincinnati, O., recently has moved into a large new plant at 666 West Fourth street. Successors to Newman Mfg. Co., the firm specializes in architectural metal work and other types of castings. New foundry equipment with five crucible furnaces for nonferrous metals has been installed in the new plant.

♦ ♦ ♦

Foundries in the Chicago district held operations during January close to the active level prevailing during the preceding quarter. Some recession developed among producers of automotive castings, but jobbing plants increased their schedules while some improvement occurred also among farm implement manufacturers. Steel foundries still are receiving but little business from railroads, though such orders are heavier than a year ago. Farm implement production also is ahead of the 1935 rate. Pig iron shipments declined about 50 per cent from the December total, due entirely to speculative buying during the fourth quarter, which increased foundry stocks materially. Foundry coke shipments were slightly ahead of the December volume.

♦ ♦ ♦

Uline Foundry Co., Ballston Spa, N. Y., has been reopened after being closed for several years. New equipment has been installed including a cupola and a furnace for melt brass, bronze and aluminum. Merrill and Arlington Uline will conduct the machine shop and Charles Uline, the foundry.

♦ ♦ ♦

Toledo Foundry & Machine Co., Toledo, O., has received an unusual rush of orders for repairing important machinery parts, which is expected to keep the plant busy for some time, according to Joseph Mock, general manager. The firm also produces a variety of castings in its foundry and in addition specializes in marine work.

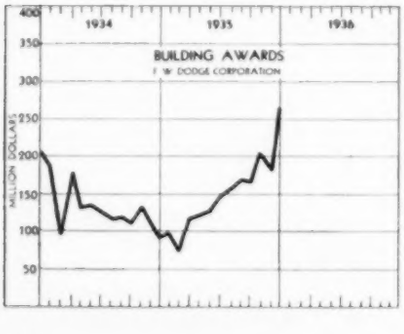
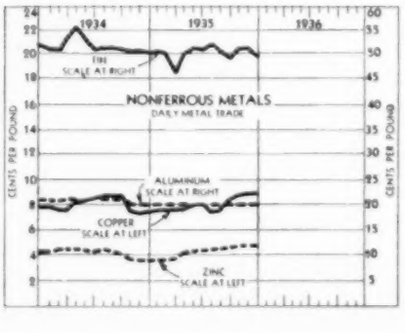
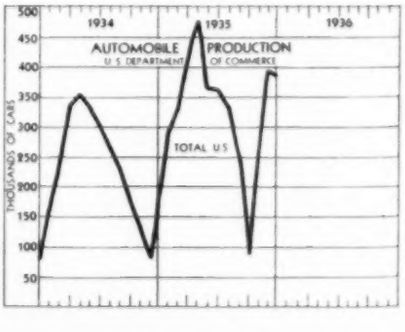
♦ ♦ ♦

Preparations for reopening the plant of the Decatur Malleable Iron Co., Decatur, Ill., were begun recently. The new concern will manufacture malleable castings for the automobile and building industries. Albert White, former foreman of the company, was recalled to take charge of the plant. The plant was established in 1916 and it's capacity is rated at 710 tons of castings per month. The main foundry building is 300 feet long and 80 feet wide and has 70 molding floors with a centrally located furnace. The adjoining core room is 80 feet long and 40 feet wide. Other facilities include pattern and machine shops, a hard iron room and annealing room with annealing ovens, etc. The property has been idle since last June. The plant is being reopened under the management of the Illinois Malleable Iron Co., Chicago.

NEW Trade Publications

ALLOY PIG IRON—A 24-page illustrated booklet "Silvery Mayari Alloy Iron" recently has been issued by the Bethlehem Steel Co., Bethlehem, Pa. The text presents pertinent facts for foundry and other uses of Silvery Mayari, a natural nickel-chromium iron with high silicon content. The publication also presents essential information for users of foundry products interested in high strength alloy iron as a medium for high test machinable castings.

PUMPS—David Brown & Sons (Hudd) Ltd., Huddersfield, England, has published a folder on its Roloid helical rotor pumps obtainable for heavy duty and medium duty. Advantages are discussed and specifications presented.

ENAMEL—Porcelain Enamel & Mfg. Co., Baltimore, has published an exceptionally well illustrated bulletin celebrating the twenty-first anniversary of the founding of the company. Information is presented upon the care exercised in the manufacture of a uniform frit suitable for a number of uses, including cast iron frits.

BOND — Harbison-Walker Refractories Co., 1800 Farmers Bank building, Pittsburgh, has published three bulletins, one describing its firebond for laying fireclay, super fireclay, high alumina and silica brick; the second discusses thermolith for laying magnesite, chrome, fireclay, super fireclay, high-alumina and silica brick; and the third harwaco bond for laying fireclay, super fireclay and high-alumina brick. Features claimed for the three different products are discussed.